# ENGINEERING NEWS

A PUBLISHED interview with Mr. HENRY B. SLAVEN, the President of the American Contracting and Dredging Co., which has executed much of the work so far done on the Panama canal, gives the following concerning the latest plans of M. de LESSEPS and the present condition of the canal: He says the canal is "more than half done;" it is open for vessels drawing 15 ft. of water for 13.4 miles out of a total of 45.88 miles; the 12.4 miles represents work done by his own company on the Atlantic side. He expects to have about 15 miles finished by July 1, 1888, and a French company will, about the same time, finish 3 miles on the Pacific side. Beyond his work is about 15 miles on which very little is done at all, though it is under a French contract. But the 15.5 miles containing the Culebra ridge, over 300 ft. above sea level, while it has considerable work done on it presents the real difficulty. It is this Culebra section that M. de LESSEPS now proposes to cross by a series of "temporary locks," mainly constructed of iron, and M. EIFFEL is reported as having taken the contract and will visit the canal in January. The number and detail of the locks is not yet determined. Mr. SLAVEN says he has no immediate fear about money, as the Canal Company has $35,000,000 cash in hand, and he has had no trouble in getting his pay. Mr. SLAVEN thinks that ships can cross in 3 years from January 1 next, and says that de LESSEPS "denies that he ever said that the canal would be opened in February, 1889." In regard to this denial we can only remark that if M. de LESSEPS is correctly reported this time a great many "somebodies" have been indulging in some very elegant lying in reporting a half dozen or more of his speeches to stockholders, and among these the official organ of the canal has been figuring.

THE Jersey City Board of Public Works have passed over the Mayor's veto the resolution permitting the Pennsylvania Railroad Co. to elevate its tracks in that city. The explanation given of the veto is that the Mayor owns property that would be damaged by the proposed improvement, and he and others similarly situated will now take the matter into the courts.

THE *London Economist*, of Nov. 7, says Panama shares are still falling, and the 1,000 franc 3 per cent. bonds issued last year at 450 francs are now 360, and the second series of the same class of bonds issued at 440 francs, are now 375. M. de LESSEPS is to renew his demand upon the French Minister of Finance for an authorization of a lottery to raise 565,000,000 francs ($113,000,000) that will be required down to 1890, and for a further sum for an optional "conversion of the old loans. The *Economist* says, This demand will, no doubt, cause considerable embarrassment to the Government, which will be placed in the alternative of abandoning to its fate a work in which national *amour propre* and 900,000,000 fr. of French capital are engaged, or of taking the moral responsibility of causing a further sum of nearly 600,000,000 of French savings to be invested in an undertaking the ultimate success of which is still uncertain."

THE Westinghouse freight train brake tests have been continued at Philadelphia, there repeating almost precisely the records which have already been made at New York and nearly a dozen other places. The quickest stop, with the high brake power, 27,000 lbs. per car, was made in 87 ft., against 91 ft. at New York but it was a fractionally inferior performance, since both the grade and the speed were somewhat less. The comparative test with a passenger train appears as reported in the papers to be somewhat better for the latter than at New York, the comparative time of stop (distance not given) having been 17 and 23 seconds, or only 35 per cent. difference, but as the total *length* of stop (the important matter) is roughly as the square of the time the two performances really compare as $17^2$ to $23^2$, or 1 to 1.83, which means several hundred feet of quite unnecessary running after the emergency has been discovered. Saving this, would save a full half of the wreckage from collisions. The trip of this great train of 50 cars will be long memorable, and we are sure will lead to great results.

THE steamship *Hondo* sailed on Wednesday, Nov. 30, and not on the preceding Saturday as was previously proposed, with the Nicaragua Canal Construction Co's. survey expedition, and was accompanied down the bay by the steamer *Sam Sloan* with a large party of Company officials, engineers and newspaper men on board to take leave of the expedition and celebrate the first practical step toward the actual execution of the work. The party is large enough to make a very thorough preliminary survey of the work, as there are only 40 miles of canal proper, with 129 miles of river and lake navigation. Few expeditions have ever started from this country to which we more heartily wished complete success.

THE Maine Central Railroad has recently issued orders to its trainmen that all passenger trains shall make the accustomed stops at grade crossings (i. e., where the line crosses that of other roads), with the hand brakes. This is stated to be "in view of the fact that the air brakes sometimes, though rarely, fail to work, which it is very important shall never occur at these junction points." This would seem to be a not unwise measure to keep the passenger "brakeman" in memory of the fact that his nominal duty is to brake, but a more sensible improvement on the Maine Central and all other roads would be to protect their crossings by interlocking apparatus, and make no stops there at all, and adopt more vigorous measures to insure that the air brakes shall not fail, which can only come from carelessness, rather than to provide for a more certain shutting of a stable door which never need nor ought to be open.

THE latest news from the Hoosac tunnel says that the Westinghouse Electric Light Co. is finally at work introducing a system of incandescent electric lights placed 40 ft. apart through the entire 4¾ miles of the tunnel. The lights will be 40 ft. apart on each side of the tunnel but alternated so that they will be only 20 ft. apart. This lighting of the tunnel is to facilitate inspection and repair, now difficult by reason of defective ventilation and an accumulation of smoke. About 100 men are usually employed in the tunnel, but heretofore ¼ of these have had to act as torch holders. Eight heavy copper wires in two-V-shaped boxes alongside the track will carry the electric current to 1,300 lamps in all.

THE experiments with the incandescent electric light, which have been made at the Torpedo Station at Newport, R. I., are stated to have developed a novel use for the little lamps and one that is said to promise to be of great value in naval warfare. With lamps of about 100-candle power fastened on the ends of poles submerged in the sea to a depth of 20 ft. the water is so illuminated that objects in it can be distinguished within a radius of 150 ft. There is alleged to be little or no glare from the submerged light to betray the presence of the boat using the spars. It is believed that by this means a boat might countermine an enemy's field of submarine mines by cutting their cables or sweeping them to one side.

FOUR track roads bid fair to be no novelty much longer. The great New York Central stretch from Albany to Buffalo, 298 miles, will doubtless long continue the longest in the country or in the world, but the Pennsylvania has a quadruple track between Jersey City and Philadelphia, 91 miles, nearly completed, and the New York, New Haven & Hartford is rapidly pushing work on the 73 miles between New York and New Haven. With the 10 miles now under way, 23 miles will be already provided for, and work on the remaining 50 will then be pushed continuously and rapidly. These three are the first of such lines but we may be sure they will not be the last.

RUMOR from Toledo, Ohio, says that the Standard Oil Company contemplates building a new pipe line from Chicago to New York by way of the Ohio and Pennsylvania oil fields. As reported, the line is to be 1,000 miles long, and to cost $5,000,000. The high railroad rates and the inter-State commerce law are said to make this step necessary. The press reports do not state whether this is to be an entirely new line, or one to connect with the double 6-in. pipe line already laid from Olean to New York, or the 6-in. line from the Pennsylvania oil fields now extending to Philadelphia.

THE Reading R. R. Co. is experimenting in the Mahanoy Valley with a series of reservoirs and lime treatment in an attempt to utilize the water pumped from the coal mines, for boiler feeding and also for domestic purposes. The experiments so far promise to successfully remove the objectionable acids.

MR. T. A. WALKER, of Great George St., Westminster, and of King St., Manchester, is the sole contractor for the Manchester ship canal; contract price, $30,000,000. The contract is divided into nine sections of 4¼ miles each. Mr. LEADER WILLIAMS is engineer. To complete the work in four years as contemplated, nearly 18,000 laborers may be required. The canal will be 26 ft. deep and have a minimum bottom width of 120 ft.

Capt. BUNCE, of the *Atlanta*, has been refuting in a very practical way, at Newport, the charge of Commander HOFF, of the *Ossipee*, that the new HERRESHOFF steam launches were merely race horses, while the Navy needed draught horses in its steam launch service. A test was made by connecting launches of the old and new type stern to stern by a hawser, and then steaming away from each other. The result was that the *Atlanta's* HERRESHOFF towed off the *Ossipee's* launch at such a rate of speed that Commander HOFF in another steam launch of the old type could not keep up with the handicapped fast and strong launch. The victory was complete and the proof positive that the HERRESHOFF combined the qualities of the race *and* the draught horse.

CHICAGO proposes to erect a 20,000,000 gails. auxiliary pumping station on the West Side near the land end of the new lake tunnel, about Desplaines and Taylor streets. The buildings would cost about $35,000. A new main would also be laid connecting the new works with Cicero. This plan is in addition to those already proposed in connection with the new tunnel, which latter will yield 90,000,000 galls. daily.

SAN FRANCISCO people interested in commerce are again advocating a submarine cable to the Sandwich Islands and thence to Asia. There would be two cables to the Islands, one starting at San Francisco and one at San Diego. From the Islands one main stem would proceed south through the Phœnix, Samoa and Fiji islands to Brisbane, Australia, and another would run north to the Boin Islands and to Yokohama, Japan. From Japan a supplementary line would connect with China. The naval officers who have made the survey report the bottom of the Pacific as very uneven and with a maximum depth of 27,800 ft. and in some places very swift currents. The route to Honolulu is even and good.

THE following bridge accidents are reported: On Nov. 21 a part of the north abutment being built for the new Dearborn street bridge at Chicago, Ill., fell into the river, owing to insufficient foundation. Piles could not be driven for the foundation because of the gas tunnels under the river. The damage was about $2,000.——On Nov. 25 the bridge on the Shamokin & Lewisburg branch of the Philadelphia & Reading Railroad, across the Susquehanna canal, near Milton, Pa., was badly damaged by a collision between two freight engines, both of which were thrown off the bridge.

The most serious railroad accident of the week was a head collision, Nov. 25, on the Wheeling division of the Baltimore & Ohio Railroad, near Cochran's Mills, 15 miles from Pittsburg, Pa. Two fast freight trains met on a curve, being hidden from one another until there was no time to avert the accident. Both engines and all the cars were wrecked. Three men were killed and five seriously injured. The telegraph operator is blamed for not delivering orders.——A head collision occurred Nov. 23 between two freight trains on the Cincinnati Southern Railroad, near Nemo, Tenn. Two men were killed and two seriously injured. The telegraph operator and the conductor of the north bound train are held responsible.——A misplaced switch at Frazer's, Pa., on the Pennsylvania Railroad, derailed a freight train on Nov. 24. Six cars were wrecked.

THE rate of immigration is falling off, and we are very glad to see it. It was for

| | 1887. | 1886. |
|---|---|---|
| Month of October - - - | 43,699 | 39,228. |
| 4 mos. ending October - - | 168,248 | 143,859. |
| 10 mos. ending " - - | 454,699 | 333,824. |

These figures do not include the immigration from and through Canada, which is very large. According to the official Canadian figures, considerably more than half of the immigrants which arrive in Canada by steamer are ticketed through the United States (quoting simply from memory, 68,000 out of 128,000 arrived), and these do not appear at all in our official statistics of immigration, for the reason that there is no machinery for collecting the records along the Canadian frontier.

THE native Canadian immigration to this country is also very heavy. In 1870 there were 493,464 native Canadians residing in this country, against a home population a year later of 3,906.81, or 1 in 7.9. In 1880 this had increased to 717,157 against a home population of about 4,500,000, or 1 in 6.3. In the two provinces of Quebec and Ontario it reached the enormous proportion of 610,000 against 3,345,000 or 1 in 5.5. When we consider that this immigration, like all other, is chiefly of men of the most vigorous age, and includes comparatively few of the very old or the very young, it importance as a sign of current tendencies can hardly be over-estimated. As a consequence of it, Canada increased in population only 17.2 per cent. between 1871 and 1881, against 34 per cent. in the United States. The Canadians and the best of the European immigration is welcome, but it is a pity that a mode cannot be devised to keep out the poorer third or fourth of the people who now come to this country.

## The G..ng Well System at Fort Worth, Tex.

The water supply for the city has been taken heretofore from the Trinity river, through cribs, but the contractor for the new water supply, Mr. F. O. Brown, is now putting in 95 2-in. wells, 24 ft. deep, in the gravel bed under the river; these wells are to be connected with a suction pipe running up and down the river from the pump house, a distance in all of 800 ft. The wells are sunk 9 ft. apart, on alternate sides of the main and 3 ft. from it, they are tapped into the main, which is extra heavy, and which is connected with the wells by 2-in. pipes containing union and globe valves; the lateral pipe is connected with the well by means of a tee, and a vacuum chamber, 18 ins. long, is formed above this 2-in. pipe connection, which has the effect of making the inflow from the wells steady and regular. At the junction of the main suction pipe with the suction pipe leading to the pumps, which are situated back on the bank of the river a distance of about 100 ft., is located a sediment receiver 30 ins. diameter and 6 ft. long, fitted at one end with a connection with the delivery mains, with stop valve, and at the other end with a blow-out to the river; the object of this receiver is to collect any sand and sediment which may find its way through the well points and prevent it from being drawn into the pumps. The receiver can be blown out when necessary.

The well points are 2 ins. diameter inside and 6 ft. in length, perforated with 400 ⅝-in. holes and covered with 2 thicknesses of brass wire gauze, the first 60 and the second 100 to the inch; outside of these is a brass jacket perforated with ⅛-in. holes, the object of this latter is to protect the gauze in driving through any hard substance. The wells are sunk by means of hydraulic tubes sunk in the gravel, which clear the way for the well points. After the well is sunk clear water is forced through it from the inside, which causes all the mud, silt and fine sand to come to the surface, when it is removed and coarse gravel put in its place, which settles around the points and forms a reservoir for the water. The points as above described furnish readily 35 galls. of water per minute. Where gauze 60 to the inch is used they will furnish from 60 to 80 galls. per minute. There are Holly pumps and one Worthington pump at the works.

About 60 wells have already been sunk just under the bluff between the pump house and the river. Underneath the river there is a bed of gravel 35 ft. deep, and through this the water is always percolating, so that when the bed of the stream is dry the wells will continue to supply water. It is expected that 95 wells will furnish an ample supply, but if not, it will be easy to sink others.

We are indebted to Mr. BROWN for the above information.

## Should Storage Reservoirs be Opened or Closed?*

In endeavoring to treat upon this very important question, I find myself at the very outset, beset with difficulties and knotty problems far beyond the abilities of your humble servant to cope with. Although the title is short and comprehensive, still to enter into a complete digest of all the merits and demerits of both open and closed storage reservoirs, requires not only a very careful study of causes and effects, covering a long period of time, but a considerable knowledge of chemistry, in order to more fully explain to the comprehension of others, the full nature of such causes and effects. We find that we have a large varied condition of circumstances to contend with, such as climate, capacity, quality of water, temperature, condition of atmosphere, material of which reservoir is constructed, and many other elements and conditions, making the subject one of too great magnitude to attempt to cover by a single paper, before your honorable Association; however, I will endeavor to present for your consideration, such facts as are readily obtainable with my limited knowledge and ability. In order to avail myself somewhat of the knowledge and experience of others, several months since I sent out over 100 circulars to Water Works Officials, using reservoirs both open and closed, in the form of questions on this subject, as follows:

1. Name and address of your system.
2. Is your reservoir open or closed.
3. Capacity of reservoir in gallons.
4. How built, of earth, brick or stone.
5. Source of supply of water.
6. Quality of water before entering reservoir.
7. Quality of water after standing in reservoir.
8. How often do you find it necessary to clean out the reservoir.
9. What is the nature of matter taken out in cleaning.
10. Is reservoir troubled with frost, if so, to what extent.
11. Is water affected by action of sun, if so how can it be prevented.
12. Is water in reservoir affected at times with bad odor or taste, such as fishy, woody, musty, nauseous, cucumber, vegetable or any other disagreeable odor or taste, if so, is it more discernible at one time of year than another, and what time does it occur how can it be remedied or prevented, is water ever polluted by fungus or mossy growth, such as algæ, etc., in what kind of water is this most likely to occur and how can it be prevented. Please give any other information in your possession bearing upon this subject.

To which I have, at this date, June 28th, received several replies, many of which are answers in monosylables to questions asked, still quite a number are more lengthy and contain much valuable information. I allude to a few of these bearing more directly on the subject as follows:

St. Louis, Mo., open reservoir, 60,000,000 galls. capacity; built of earth, stone facing, walls in center of embankment; source of supply, Mississippi river, has not been cleaned since built in 1871, about 1 ft. of deposit; water not affected by sun or atmosphere, no fungus or mossy growth, algæ or other substance, no bad odor, taste or smell at any time.

Hannibal, Mo.; open reservoir, 1,500,000 galls. capacity, water good before being pumped to reservoir, better after standing, cleaned once a year; sediment, silt; not perceptibly affected by sun or atmosphere, no fungus or mossy growth, no bad taste or smell at any time.

Quincy, Ills.; open reservoir, 22,000,000 galls. capacity, built of earth, stone lining; source of supply, Mississippi river, not yet necessary to clean, in use 5 years; has a vegetable growth in summer, a hairy, filtrous moss, has a pronounced fishy taste in hot weather, but this does not seem to be due to anything in reservoir, as it is not apparent in water dipped up from reservoir, it is apparently due to some condition of the pipes; we have found it remedied largely by blowing off all the fire hydrants, and have concluded that the dead or bilgy water in the hydrant connections with the mains gave rise to it.

Muscatine, Ia.; reservoirs closed, capacity 2,000,000 galls., built of earth, brick and cement; source of supply, Mississippi river; clean out twice a year, sediment river mud; no bad effects from sun or atmosphere, as after standing a week at a time water seems as good and pure as ever; reservoir 20 ft. deep, sides 128 × 140, slopes 1½ to 1.

WM. MOLIS, Superintendent, writes: in regard to bad taste or odor, we have never experienced any trouble in that way, the only trouble we have is a green scum, a vegetable growth of cryptogamous nature, full of animalcula which when exposed to the sun, out of water, gives forth a fetid odor. This growth never goes below the surface; always found on top, the growth is, or develops into the snail order, as found by experiment by letting them hatch out under a glass case, but then we have not found the first sign of them in our pipes, and on cleaning out reservoirs it disappears entirely. I think all reservoirs in this section of country are affected in the same way.

Savanna, Ill.; reservoir closed, built of stone and cement; capacity, 800,000 galls.; source of supply, Mississippi river, at times a little muddy and a slight swampy nature, after standing find water much improved. W. H. GRIFFITH, Chairman Board of Water Commissioners, writes: at present, use of water about 1,000,000 galls. per week, we find that cleaning out once a year is sufficient; sediment, a soft mud of a dark gray color; have had no trouble with frost whatever. As to the action and effect that sun has on water stored in large reservoirs, my experience has not been very large, still I think the heat of the sun does create a growth of green fungus matter. On a recent visit to St. Catharines, Ont., where the superintendent is a relative of mine, I find that they are troubled with a heavy growth of moss, so that it was difficult to get a small boat through, although reservoir was thoroughly cleaned every season at great expense. My preventive would be to construct a reservoir such as we have here, cemented on inside and with a good roof; clean it out as often as necessary, and the trouble of fungus or mossy growth will be obviated.

Decorah, Ia.; reservoir closed; capacity 500,000 galls.; stone cemented: source of supply, well; not cleaned since built in 1881. An analysis shows it to be the best water in the city, no bad taste, odor or fungus growth of any kind.

R. B. TUTTLE, Chairman of Water Works Committee at time works were built in 1881, writes: I am not a member of City Council at present, but believe that with open reservoirs the utmost care has to be taken to prevent the water from being contaminated by fungus matter that would be prejudical to the health of those using it. At Sioux City, Ia., their reservoir is enclosed with a wire screen and in addition, a man employed by the year to guard it. Diphtheria prevailed to some extent, in Decorah, last winter, and an analysis of the water from the different sources of supply showed that the water taken from the reservoir was the purest that could be obtained. I wish I was more fully able to give you information on a matter of such great importance.

D. C. FRY, Superintendent Water Works, Jacksonville, Ills., writes: our reservoirs are all open, the impounding reservoir holds 80,000,000 galls., fed from surface water, springs and from tilled land; giving a description of the manner reservoirs are built; have cleaned reservoir every 2 years; sediment, mud, black dirt and fish; are not troubled with frost; water is affected in distributing reservoir a little by the sun in month of August, not affected with bad odor. We pump into distributing reservoir every day, which keeps it pure, if allowed to stand for a long time it would become stagnant.

Newport, Ky.; reservoir open; capacity 40,000,000 galls.; source of supply, Ohio river; does not need cleaning, although in use 14 years. Since works have been in operation there have been but very few occasions when water was affected by bad odor or taste, in those instances, however, it was decidedly fishy; as consumption has increased and more frequent renewals of supply to the basins, the trouble has ceased, it is about 5 years since the last case, have never had any trouble, except in mild or warm weather.

Catskill, N. Y.; reservoir open, capacity 4,500,000 galls.; source of supply, Hudson river. F. P. SMITH, Superintendent, writes: reservoir has not been cleaned since built in 1885, do not consider that action of sun has any effect on water; water has been affected once in each year since works were put in operation, with a fishy odor and an oily, nauseous taste, commencing about May 15 and disappearing in about 2 weeks; this spring the taste and smell came promptly on time, and I immediately had the mains thoroughly flushed, the taste and smell continued only 2 days after. My opinion, however, is that the condition of the water is due to other cause than filthy water mains, but I am not at present prepared to give a decided opinion as to what the cause is.

Akron, O.; H. C. STAR, Secretary and Treasurer, writes: I can answer some of your easy questions, but the hard ones I will let some one else wrestle with. Reservoir open, 6,000,000 galls. capacity; source of supply, lake and well, quality about the same as Lake Erie; we keep water in motion by pumping, still when water is low and sun shining, there will a substance grow and rise on the water of a mossy growth or perhaps algæ: two years ago we had a severe dose of fishy taste and smell and have had it mildly at various times since; as to the cause doctors disagree.

Ithaca, N. Y.; J. L. MORRIS, of Cornell University, writes: Reservoir open, capacity 1,000,000 galls.; supply from Fall creek, clean out twice a year, water somewhat affected by sun, remedied by pumping in and opening overflow, sometimes a fishy taste in summer time, no moss, remedy open hydrants and blow off;

*Paper read by Mr. E. G. BEACH, of Minneapolis, Minn., at the Seventh Annual Meeting of the American Water-Works Association. From the Proceedings of the Association.

four open reservoirs well fenced in, too expensive to cover them.

Lynn, Mass.; reservoir open, capacity 20,000,000 galls.; source of supply, small stream, cleaned once in 13 years. DANIEL WALDEN, Superintendent, writes: after explaining impounding basins, our theory has been that the bad odor and taste came from the ponds being newly made, and our experience would seem to confirm that theory.

Ottumwa, Ia.; reservoir open, capacity 2,000,000 galls.; supply, river, cleaned once in 5 years; in regard to bad odor and taste, both of them are likely to occur in extreme hot and long drouths; the fishy taste we experienced once.

Cleveland, O.; reservoir open, capacity 80,000,000 galls.; supply, Lake Erie; twice in 20 years had the fishy taste in month of July, found water in lake similarly affected, was accompanied both times by rank growth of algæ in reservoir, and protracted period of still water in lake.

Oswego, N. Y.; reservoir open, capacity 7,500,000 galls.; supply, Oswego river, with filters, clean reservoir once in 2 or 3 years; months of June, July and August sometimes gives a fishy or cucumber flavor, cannot be remedied except by expensive filtering and æration; very little fungus or mossy growth of algæ, etc., remedied by drawing off water, letting sun kill the growth, then clean it out.

Grand Rapids, Mich.: A. C. SEKELL writes: reservoir open, capacity 6,000,000 galls.; had fishy taste in time past, but know of no careful studies relating to the cause: have about 10 miles of wooden pipes, in which are many fresh water sponges. My opinion is, that storage reservoirs holding stream or surface water, may properly be left open when of large extent, and having at least 20 ft. depth, when the supply is ground or spring water, storage basins should be covered in as tightly as possible, to the exclusion of all light and air. This I think was the opinion of the late Prof NICHOLS.

Paterson, N. J.; four reservoirs, open, capacity 50,000,000 galls.; supply, Passaic river; when river is very low, water tastes fishy, river is fed by springs: pump each day what is consumed, and as water is constantly changing are never troubled with algæ.

New Bruswick, N. J.: A. J. JONES writes: reservoir open, capacity 15,000,000 galls.; description and drawing showing how built; clean out once a year; source of supply, Lawrence brook, of good quality and soft, contains at certain seasons much vegetable matter in suspension, which we believe to be the principal cause of the unpleasant odor and taste occasionally noticed, and which has been the cause of much complaint in past seasons or until 1883, since which it has gradually improved; the taste was of the fishy, woody, cucumber variety of which you speak, and although at times coming as early as June, is not generally noticed until July or August. It is not noticeable in the lake from which the water is drawn, nor was it noticed there when the water in reservoir was particularly objectionable, which led me to seek the cause between the lake and reservoir. After many fruitless efforts in other directions and some attempt to remove it or purify it without filtering the water in the reservoir, I found by experiment that the water if kept quite under pressure for two or three days, when released would emit the odor complained of, while if kept in open vessels for the same period of time it appeared to remain in good condition. We then stopped the pumps, and left the water standing in the mains for from 48 to 72 hours, and as a rule it spoiled; since then we never (if possible to avoid it) permit the water to stand in the pumping mains longer than 12 hours, and have had scarcely any trouble, although we sometimes get a trace of it. If our engines are not in operation for a day or two, which is frequently the case with us, we draw off all the water from the pumping mains before starting the pumps again. In the distribution, and particularly where the circulation is not as perfect as it should be, we resort to the frequent blowing off at hydrants. Our reservoirs are kept entirely free from any vegetable growth. I do not offer the foregoing as a solution of the difficulty by any means, but merely to give you the benefit of our investigations. I regret my inability to furnish you with more on the subject which might be of service to you in preparing what must certainly form an interesting paper.

Pierre, Dak.; J. W. TROY writes: Reservoir closed, capacity 1,000,000 galls., source of supply, settling well near Missouri river, quality of water pure and clear as it goes to reservoir; do not think it would be necessary to clean reservoir oftener than once in 2 years, as after pumping two years drew off water to clean it, but found nothing to clean out, five pails held all the sediment, which was fine sand carried through with the water from settling well. Water in well when not protected from sun, developes a fungus or mossy growth, but when protected from sun remains pure. This I have found by experimenting since the subject was discussed at Denver last year. Water in reservoir is not affected at any time with any disagreeable odor or taste, but if drawn off in vessels exposed to sun and air, it would assume a color resembling water that leather had been soaked in, and have odor like old rubber. I have made chemical tests of water here, and find quite a per cent. of magnesia or chalk with slight trace of iron and very slight trace of organic matter.

Nashville, Tenn.; GEO. REYER writes: Reservoir open, capacity 2,500,000 galls., source of supply Cumberland river very muddy after heavy rains, clean out once a year, sediments 8 to 12 in. deep, water at its worst will settle clear and pure in 48 hours. Sediment composed of sand and clay; becomes offensive when exposed to sun and air; no bad taste or smell at any time, and but little mossy growth and only in July and August when water is perfectly clear. have called attention of health officer to this growth, and he says it is not deleterious to health as it is the same as found on stones in pure streams. As to covering of reservoirs, it is my opinion that much depends on localities; if it is distant from thickly populated districts and manufactories, I do not think it necessary to have them covered, only in very cold climates; if however, they are located within or near manufactories, then it may be best to cover them. The affinity which water has for foul gases is readily shown by leaving an open vessel of water in a sleeping apartment where ventilation is poor, and after one night the water becomes very obnoxious. Chemistry informs us that strong traces of ammonia are found in dew taken from grass at considerable distance from manufactories using bituminous coal, which contains considerable free ammonia. This being the case, it strikes me that with the great affinity which water has for this particular gas, that large bodies of water would absorb considerable, especially in places where a large amount of soft coal is used as fuel.

From a careful consideration of the foregoing reports and a personal knowledge of the facts connected with many other water works and reservoirs, we are led to the following conclusion, viz.: That pure water, as taken from the earth, either from wells or springs, is by nature very productive of both animal and vegetable life, and that under favorable conditions these productions are spontaneous and without previous germination, still there are certain conditions required to spontaneously produce these growths. Some of the conditions required are as follows, viz.: That the water itself must be practically pure, that it must be of a temperature of at least 50° Fahr., that it must be exposed to sunlight and air, that it must be without pressure or at least not to exceed 5 to 8 lbs. pressure per sq. in., that it must be without contamination from sewage matter. As an illustration: Where reservoirs or basins are over 15 to 20 ft. deep, algæ is not known in the water, neither is it known in water polluted with sewage, although the mossy growth may exist in water more polluted than that which would produce algæ; as, for instance, the water of the Mississippi river, which carries the sewage of millions of people and domestic animals, is sufficiently polluted to prevent the growth of algae, still in some instances the mossy growth partially thrives, while the water is generally considered fair for domestic purposes. As to what algæ is, whether vegetable or animal growth, it is not positively known, but of either class, it is evident that it is of the lowest order and produced spontaneously by the action of the sun upon pure water of no great depth. It appears to commence its growth in the early spring-time, thriving till May or June, when it appears to mature and release its hold upon the bottoms and sides of reservoirs, rising to the surface and decaying in July and August, and producing the nauseous odor and taste so often alluded to. Since it would follow that the presence of algæ in water is good evidence of its purity, and to a certain extent, the presence of the mossy growth alluded to, is also evidence of water comparatively pure, if the above theory is correct, the next question to be considered is how to prevent such growth in pure water. This can be done in several ways. First, have reservoirs deep; second, have them covered so as to exclude sun-light and air, which materially aids in keeping temperature at its lowest point, and again by admitting a sufficient amount of sewage or filth to prevent its growth. It is no doubt a fact that many persons in charge of waterworks have declined to answer questions on this subject, where the water produced such offensive odor and taste, preferring that the public should be kept in ignorance of the fact if possible, rather than aid in solving an important problem.

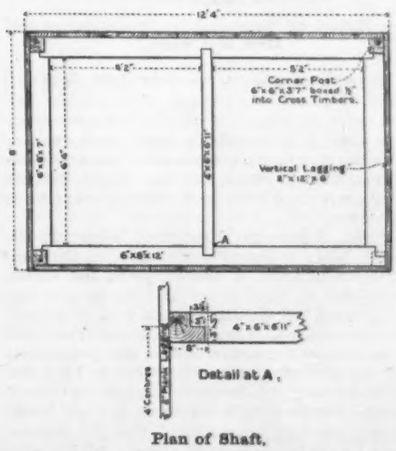
On May 8th, last, the writer obtained from a small lake, known as Buell's lake, near St. Peter, Minn., a quantity of the above described mossy growth and algæ, and has since kept it in Mississippi river water, changing water occasionally. The algæ disappeared in a very few days, while the mossy growth partially thrives. The lake referred to is of an area of about 18 acres, with a varying depth of 2 to 8 ft. This lake is supposed to be fed by springs, having no visible inlet or outlet and having a water shed of less than 5 acres, the waters of which, from the dryest to the dampest seasons, have never been known to vary to exceed 1 ft. This mossy growth grew thickest on the side of the lake from which the springs were supposed to be, and where the depth was least, none growing where water was more than 6 ft. deep. Algæ was only found near where the springs were supposed to be located. Samples of this mossy growth will be shown members of convention: an analysis of the waters of above lake has been made, but not yet received, if received in time will also be submitted.

Now to the main question, should storage reservoirs be open or closed, it would appear that if water is taken from the ground, either from wells or springs, that it is very important that the reservoirs should be completely covered so as to exclude sunlight and heat, but well ventilated; while with water taken from rivers and lakes it is of much less importance, especially when stored in large bodies. Still where it can be practically done, it would no doubt be much better to exclude sunlight from all storage reservoirs.

## Mining Shaft.

As a good example of the simpler class of shaft work we present the accompanying illustrations, with a short description and bill of cost in detail. The work was carried out on the property of the Denver R. R. Land & Coal Co. near Denver, Colo., under the directions and from the plans of Mr. W. B. PARSONS, Jr., Chief Engineer of the company. Some 15 years ago a shaft 141 ft. deep was sunk to the vein, which was afterwards abandoned and unfortunately allowed to cave in, the mine having been been opened in another place by a drift.

The old shaft was 8 ft. 4 ins. by 5 ft. 6 ins. in section, walled up with 2 in. plank, running horizontally, and butting against each other at the corners, without any "sets" or other braces, except a single cross partition of 2-in. plank dividing the shaft into a hoisting compartment about 5 ft. square and a smaller ventilating compartment at the end. This method of timbering is the practice of the coal




Plan of Shaft.

mines in that district. The planks, rotting in course of time, had given way to the pressure of the earth in several places, the slips from which had filled up the shaft for a distance of 36 ft.

It was designed to reopen this old shaft and to enlarge it into a double compartment one, each compartment being 6 ft. 4 in. × 5 ft. 2 in. in section, making the whole shaft 8 ft. × 12 ft. 4 in. out to out. The timbering consisted of 6 in. × 8 in. pieces, framed together as a "set" and stiffened in the middle by a 4 in. × 6 in. strut. The sets were spaced 4 ft. centers, and held vertically by 6 in. × 6 in. corner posts. The lagging was composed of 2 in. planks in 8 ft. lengths placed vertically. The material through which the shaft passed was much varied, consisting of sand, rotten or soft sandstone, shale, soapstone and small seams of coal. Most of it was removable with a pick, but occasionally layers were encountered requiring drilling. In order to support the weight of the timber lining, the side timbers of the sets were made 16 ft. to 18 ft. long, when these stronger layers of rock were conveniently met, so that the ends projected beyond the planking for 2 or 3 ft., resting in holes or pockets properly excavated on the top of the ledge. There were five of these supporting sets.

The mine drift having been driven to a connection with the bottom of the shaft, it was arranged to let all the excavated material fall and to remove it from the bottom through the mine, as being a more economical method than hoisting it. The work was carried on from a hanging platform, supported by a rope attached to a windlass, so that it could be lowered as desired; this platform was 4 ft. 6 in. × 7 ft.

9 in., a size which permitted its passage down the old shaft. It was composed of 2 in. plank, overlaid with 1 in. oak boards. The ends of the planks were held by 3 in. × 3 in. × ¼ in. angles, and a chain passed from each corner of the platform to a central supporting ring by which it was hung. Excavation started of course at the top and was carried down to a supporting layer of rock, when a long set was put in as described above, and the timbering was built upwards from that. That finished, excavation downward was again resumed until the next convenient ledge was reached. The excavated material was removed through the mine in the ordinary mining cars, with a haul of about ¼ mile to the dump. Each car contained 1¾ cu. yds., 10 of which cars were filled in 10 hours by 2 men, or 5 cars, equivalent to about 9 cu. yds. per day's labor. Facilities for working in the small drift were of course very poor.

The contractors in sinking the shaft, resolved themselves into their own foremen, and worked in two shifts of 10 hours each, two men and a foreman in each shift. The timber had to be hauled from the track to the site of the shaft a distance of ½ mile.

The actual cost in detail was as follows:

| | | | |
|---|---|---|---|
| Foreman | 70 days | $5 | $350.00 |
| Laborers | 120 " | 3 | 360.00 |
| Carpenter. Framing timber | 19⅓ " | 3 | 58.50 |
| Team. Hauling Timber | 2 " | 4 | 8.00 |
| Blacksmith. Sharpening tools | ⅔ " | 3 | 2.00 |
| Laborers. Removing dirt | 71⅓ " | 2.75 | 196.62 |
| " " | 8¾ " | 1.75 | 15.31 |
| Cost of tools, scaffold, etc. | | | 59.00 |
| Total labor | | | $1049.43 |

Quantities.

| | |
|---|---|
| Timber | 19,598 Feet, B. M. |
| Earth excavation | 265 Cu. Yds. |
| Earth caved in | 80 " " |

## The Effect of Temperature upon Structural Iron and Steel.*

I do not propose in this article to advance any new theory, or promulgate any new discovery, but simply to give the results of some tests and investigations which I have made in regard to a question which has long been a subject of dispute and uncertainty, and one in which, I am sorry to say, the bulk of the authorities upon iron and steel seem to be against me.

STYFFE, FAIRBAIRN, KIRKALDY, WEBSTER, the United States Government Commission, the Railroad Commissioners of Massachusetts, and others, all hold that the effect of low temperature upon iron is very slight, and that it does not tend to produce a brittle condition. SANDBERG is the only one who claims that low temperatures have any pronounced effect in producing brittleness; that is, he is the only one among the recognized authorities; but if you have ever been out in the woods on a cold frosty morning you may have noticed that the axeman warms his axe before beginning work; ask him why he does so, he will reply, "to take the frost out."

Watch the trackman on a cold morning, he is very careful not to strike his cold chisel too hard, and neither does he cut so deeply into the rail, before dropping it to break it, as he does in warm weather; ask him why, he will say, "the chisel and rail are full of frost, and will break more easily than in warm weather." The same thing will be noticed with the men who are unloading steel rails, or wheels and axles, they are more careful to let them down easily in cold than they are in warm weather.

"You may say, but that is only a popular fallacy." It may be so, but these men have had some experience which has led them to this opinion, and I am afraid that there is more truth than fallacy in their claim that "frost in the iron makes it brittle."

I have had neither time nor opportunity to complete all the tests I wished to make before submitting results, or giving my conclusions to the Society, and it is therefore with some reluctance and diffidence that I now do so, and I submit this paper more as a preliminary report of tests, than as final conclusions.

During the past winter some trouble we had with iron delivered for bridge work, and some peculiarities in tests made under different circumstances and temperature, led me to look more closely into the effect of low temperature upon the texture of the iron.

I wrote to a number of eminent bridge engineers and inspectors, submitting these questions:

1. Do you prescribe any temperature for nicked and bending tests?

2. Does temperature affect the texture of iron; that is, will iron be more crystalline at low than at high temperature?

All the replies received were unanimously in the negative.

These answers left me the alternative of either accepting these replies as settling the matter, or of making some tests myself, and as the experiments and tests reported in the books did not seem to have been made in the line of information I desired, I concluded to take the latter course and make some tests. Primarily, the question of crystallization was the one I was interested in, but the first tests made gave such a wide variation in the strength also, when tested by impact, that I combined the two questions.

In anticipation of some questions which would probably be fired at me, I wish to admit that crystalline fractures can be produced by a variety of causes, as

1. By a sudden rupture.
2. By overheating.
3. By working, or finishing too hot.
4. By working, or finishing too cold.
5. By being cooled suddenly.
6. Too much phosphorus, carbon and silicon.

Now, while admitting the above causes of crystalline fractures, I claim that a bar of iron which gives a crystalline or fibrous fracture when broken in a certain way and by blows of a certain force, should and will give the same fracture when broken again under exactly similar circumstances and blows (provided the iron is homogeneous). Therefore, if iron fractured under normal conditions as to temperature shows a good fibrous fracture, while the same iron broken under exactly the same conditions as to force used and the application of it, but varying only in the temperature of the bar, shows a crystalline fracture, and numerous tests produce the same results, the difference in the character of fracture produced must be due to the one varying condition of tests, namely, the temperature.

Does the texture of iron vary when broken under different temperature?

The tests made by the writer would seem to prove that it does, as shown in Table I.

TABLE I.

| TEST No. | 2 | 3 | 12 | 11 | 8 | 5 | 1 | 9 | 6 | 4 | 7 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp. F., deg. | 0 | 0 | 0 | 4 | 4 | 10 | 32 | 42 | 53 | 62 | 70 | 82 |
| Cry. P. c. | 70 | 70 | 50 | 60 | 60 | 70 | 25 | | 25 | | | |
| Fibrous. | 30 | 30 | 50 | 40 | 40 | 30 | 75 | 100 | 65 | 100 | 100 | 100 |
| Granular | | | | | | | | | 10 | | | |

| TEST No. | A1 | B1 | A2 | B2 | C1 | D1 | C2 | D2 |
|---|---|---|---|---|---|---|---|---|
| Tem. deg | 15 | 15 | 70 | 70 | 15 | 20 | 70 | 70 |
| Cry.. p. c. | 40 | 20 | | | 95 | 85 | 20 | 25 |
| Fibrous. | 60 | 80 | 100 | 100 | 5 | 15 | 80 | 75 |

NICK BENDING.

| TEST No. | 7 | 11 | 10 | 17 | 16 | 32 | 14 |
|---|---|---|---|---|---|---|---|
| Temper. degree. | 0 | 0 | 10 | 12 | 12 | 12 | Avg. 60 |
| Crystalline, p. c. | 60 | 40 | 25 | 30 | 25 | 20 | |
| Fibrous. | | | | | | | Avg 100 |
| Size of bar. | 1" rd. | ¾" | ¾" | 4½x1¼ | 4½x1¼ | | |

Tests 1 to 10 were with a 96 lb. drop; bearings, 10⅓ ins.; size of bar, 4½ × 1¼ ins. Tests A and B were by bending press, and stress applied gradually; C and D by drop test, drop 53 lb.; bearing, 9½; A, B, C and D tests from same bar, 4 × 1¼ ins.

All of these above tests were made from exactly the same iron, made under the supervision of Mr. A. E. HUNT, from the best bar iron mixture of Carnegie Bros. & Co., Limited. The muck bars were double rolled into the 4 × 1¼ in. bars used for tests. These bars were tested many times to prove their homogeneity.

The analysis of drillings of the 4 × 1¼ bar iron were made by the Pittsburg Testing Laboratory. The drillings being taken in the one case from the fibrous fracture of one of the tests made at 70° F., and the other from the crystalline fracture of one of the tests that broke at 0 F.

| | Per cent. in Fibrous Frac. | Per cent. in Crystalline Frac. |
|---|---|---|
| Phosphorus | 0.[illegible] per cent. | 0.[illegible] per cent. |
| Sulphur | 0.[illegible] " | 0.[illegible] " |
| Silica existing as slag in the iron | 0.[illegible] " | 0.[illegible] " |

Test No. 6, at 52° temperature shows 25 per cent crystalline, while No. 9, at 42°, shows 100 per cent fibrous. This anomaly is explained by the fact that in test No. 6, the test piece was reversed after each blow, and, therefore, broken by bending in alternate directions, required three blows, while No. 9, was not reversed and required fifteen blows. This 25 per cent. crystalline was undoubtedly due to the sudden rupture of the piece, owing to quick changes in stresses from compression to tension, and *vice versa*, and not to the temperature.

Besides the tests above given, I made a larger number of nicking and bending tests by hammer (as generally required by specification), and the fractures obtained invariably were largely crystalline under low temperature, and fibrous at high temperature. Memoranda were made of these tests, but have been mislaid.

The question whether crystallization is caused by low temperature, thereby producing a brittle or cold short iron, which is easily ruptured by a sudden shock of impact, or whether the low temperature makes the iron brittle, causing it to rupture suddenly under the shock or impact, and the sudden rupture of the fibres of the iron produces the appearance of crystallization, is one I do not care about arguing; it seems to me to be a question of tweedledee or tweedledum. It cannot affect the result, as the iron is broken and the fracture is crystalline.

Probably it will be claimed that the crystallization is due to too much phosphorus in the iron, and that if the iron had less phosphorus it would not show this crystalline fracture when broken at low temperature. Admitting this, if the effect of low temperature upon the phosphorus is to produce crystallization, while high temperature gives a fibrous texture, is it not still true that this change in the texture is due to the effect of temperature? If at normal temperature the iron is fibrous and at a low temperature crystalline.

As regards the effect of temperature upon the tensile strength of iron, I do not believe that low temperatures reduce the ultimate strength, when the load is applied gradually. On the contrary, I believe it is increased slightly, due to the hardening effect of the low temperature, just as tempering and hardening of steel or iron increases the ultimate tensile strength. In preparing for our tests I stated my belief as above, and I found it supported by tests for tensile strength in the testing machine. When we come, however, to examine into the strength of iron to resist sudden shock or impact when it is exposed to low temperature, we obtain surprising results, such as seem to call for more thorough and exhaustive tests than have heretofore been made.

The tests made for tensile strength and elasticity I will not tabulate in this article, but only state that they showed that there was no decrease in either strength or elasticity under gradual stress, if anything, there was an increase in both. The character of the fractures showed that the low temperature still caused crystalline fractures. In all the tests below 10° F. there were from 10 to 15 per cent. crystals, while above 10° temperature every fracture was 100 per cent. fibrous.

The tests by impact were made by a drop weight falling upon a pin, 2 ins. in diameter, which rested over the groove cut in test piece.

Table II gives the results of tests made at Cincinnati by bending in a press and by a drop weight.

TABLE II.

*Tests made by bending press around 2-in. pin and by drop weighing 53 lbs., falling 6 ft. on 2-in. pin lying on test piece, bearings 9¼ ins. apart; A and B tests were by bending in press.*

| TEST. | A1 | A2 | B1 | B2 | C1 | C2 | D1 | D2 |
|---|---|---|---|---|---|---|---|---|
| Temperature Fahr. | 15 | 70 | 15 | 70 | 15 | 70 | 20 | 70 |
| No. of blows | ..... | ..... | ..... | ..... | 6 | 21 | 5 | 16 |
| Rupture completed | Yes | No | Yes | No | Yes | No | Yes | No |
| Angle of rupture | 90 | 130 | 90 | 140 | 15 | 115 | 25 | 115 |
| Crystalline, per cent. | 40 | | 20 | | 95 | 20 | 85 | 25 |
| Fibrous, per cent. | 60 | 100 | 80 | 100 | 5 | 80 | 15 | 75 |

All the above test pieces were taken from a bar of bridge iron 4×1, 6 ft. long. It was cut into four pieces 18 ins. long, and each piece grooved in a planer ⅛ in. deep on both sides, and 6 ins. from each end, making two tests on each 18-in. piece, one test at low temperature and one at high temperature. This iron has been regularly tested and accepted by the Pittsburg Testing Laboratory, and was also ex-

*A paper read before the Engineers' Society of Western Pennsylvania, Oct 18, 1887, by JOS. RAMSEY.

amined by a number of engineers and approved as good bridge iron. The tests at normal temperature gave ultimate strength—50,000 lbs. and 100 per cent. fibrous; elastic limit, 26,000; elongation, 15 per cent. in 8 ins.

These tests made me desirous of making more, and in a more thorough manner, and I arranged with Mr. ALFRED E. HUNT, of the Pittsburg Testing Laboratory, who had from the first taken great interest in the matter and tendered me his aid and assistance, for a series of tests to be made at Pittsburg.

The series of tests decided upon were quite exhaustive, and had we been able to fully carry it out, would have given some reliable data, and I think would have gone a long way towards settling the question.

The tests were to be as follows: Material to be tested:

Steel—¾ in. round, 1 in. round, and 4½×1¼ ins.
Iron—¾ " " 1 " " " 4½×1¼ "

All of the test pieces of each size were to be from one bar, so that there could be no variation in the character of the material.

1. Several test pieces were to be taken from each bar and tested at normal temperature (70°) for ultimate strength, elasticity, elongation and texture.

2. Tests for tensile strength, etc., at different temperatures from 0 up to 90°.

3. Tests of texture by nick bending tests, and cold bending test at various temperatures.

4. Tests by impact (blow transverse to fibre of bar) at various temperatures.

5. Tests by impact, parallel with fibre, at various temperatures.

6. Tests of full size members under an initial stress of 20,000 lbs. per sq. in., at various temperatures, by impact, transverse to initial stress.

Three days were spent on these tests in very inclement weather, but owing to unforeseen delays, we were unable to complete the series; Nos. 5 and 6, which I consider probably the most important, we were obliged to lay over for some more convenient season.

The result of No. 1 tests are not given in tabulated form, the results were uniform, showing good No. 1 iron, ductile and homogeneous. Average of tests gave:

| | Ultimate Strength. | Elasticity. | Reduction of Area. |
|---|---|---|---|
| ¾-in. iron..... | 52470 | 30110 | 37.26 per cent. |
| 1-in. " ..... | 51352 | 29120 | 34.38 " " |
| 4½×1¼ " ..... | 48880 | 27840 | 21.30 " " |

At low temperature from 0 to 12°, the average of Test No. 2 gave:

| | Ultimate Strength. | Elastic Limit. | Reduction of Area. |
|---|---|---|---|
| ¾-in. round..... | 54290 | 34790 | 31.84 per cent |
| 1-in. " ..... | 54100 | 29360 | 29.64 " |
| 4½×1¼ " ..... | 50095 | 29865 | 27.71 " " |

The increase in ultimate strength and elastic limit of low over normal temperature, was as follows:

| | Ultimate Strength. | Elastic Limit. |
|---|---|---|
| ¾ in. round..... | 3.41 per cent. | 15.54 per cent. |
| 1-in. " ..... | 5.33 " " | 0.82 " " |
| 4½×1¼ " ..... | 4.33 " " | 7.27 " " |

It would require many more tests than I was able to make to determine properly the effect upon the ultimate strength, elastic limit and reduction, but I believe I am warranted in making the statement that the ultimate strength and elastic limit is increased, and per cent. of reduction of area decreased, when iron is subject to low temperature.

The results of our tests by impact are shown in Table IV, and by cold bending and nick bending in Table III.

In all tests where the stress is applied gradually the temperature of the test pieces is raised greatly before the point of rupture is reached, and therefore the cold bending tests do not really show what the temperature was at the completion of test, or the full effect of low temperature, the temperature given being that of bar at commencement of test and is about 30° lower than at completion of tests, still the table shows quite a reduction of ductility in the low temperature test pieces.

When we come to the nick bending tests (Table III) we find a very decided difference in the texture when broken at the different temperatures; this is more fully shown in Table I.

In Table V. we find, in the opinion of the writer, matters for serious consideration. In these tests the whole matter is brought to a practical basis, and the one in which, as railroad men and bridge builders, we are most interested. Bridges are not subject to stress gradually and regularly applied, requiring from 1⅔ to 2 minutes to reach the maximum load, as in testing machines, but the stress upon most of the members is applied suddenly in the form of a blow, intensified frequently by "jumps" as the engine comes on the bridge when the track surface is bad. In the case of stringers and floor-beams, floor-beam hangers and connections, the greatest load is applied by fast trains in from ¼ to ⅓ of a second; must not the impact of such a sudden application of a heavy load be considerable?

In considering Table V. it must be borne in mind that all the test pieces were from the same bar, contiguous to each other. The iron was homogeneous and exactly similar in all its constituents, phosphorus, carbon, silicon, impurities, etc., being the best grade of iron made by the Union Mills and furnished expressly for these tests, the only varying condition being the temperature. The lowest number of blows required being 1⅓ blows at zero, the highest 21 at 62° temperature. The average blow at 4° and below being 2 4-10, while above 42° the average was 18 blows, without complete rupture.

I believe that at 15° to 20° the resistance to impact is not more than 25 to 30 per cent., and that for temperatures as low as 0 to 10° not more than 10 to 15 per cent. of the resistance at 70°; and at such low temperature as 20° F. it is nearly in the condition, as regards brittleness, of cast-iron. More thorough investigations may not support this opinion, but I believe they will.

During my investigation of this question, Mr. HUNT gave me an account of the breakage of a 12-in. channel beam during the erection of a large highway bridge in the Northwest, by its falling a distance of 10 ft., and striking a post, the 12-in. channel breaking short off with 30 per cent. crystalline. Mr. HUNT was called on to make an inspection of the beam, and, as the temperature at the time of the breakage was zero, he thought it a good opportunity to test the question of effect of temperature. He had inspected the iron at the mills and knew it to be good ductile iron. Specimen pieces were cut out adjoining the break, and two taken into a shop and warmed up to 70°. In the bending test the iron closed on itself, and the nicked bending test gave 100 per cent. fibrous, the other two specimens were placed outside with temperature of zero degrees, and after being cooled down to that temperature, were tested and both gave 100 per cent. crystalline.

It seems to me that such an effect by low temperature upon iron and other metals (as crystallization and hardening) is not antagonistic to the natural laws governing such metals as are solid at one temperature and become liquids at a higher one. Heat changes iron from a hard dense mass, that can hardly be affected by external pressure, to one that can easily be drawn out and worked into any shape with a light hammer: increase the heat, and the mass is in a pasty condition, where it can be rolled and worked like a piece of dough; still further increase the heat, and it is a liquid, and will flow like water. Now take the reverse process. At 70° it is hard and rigid, reduce the temperature 100°, or to 30°; and why should it not become harder and more rigid? As the fluid iron has changed into a solid fibrous material by reducing the temperature why should not a further reduction of temperature change the fibrous to a crystalline structure?

One eminent bridge engineer writes me that such changes in the texture (fibrous to crystalline and crystalline to fibrous), which would occur frequently under the quick changes of the temperature in this latitude, would soon result in the disintegration of the iron, but I cannot see that this result would naturally follow, any more than the freezing and thawing of water would result in the disintegration of the water.

Another bridge engineer wrote me that temperature did not affect iron or steel; for instance, the breaking of rails in winter was not due to the "frost in the rail," but to the frost in the ballast, making the bearing so rigid and unyielding as to increase the shock to the rails.

The latter fact has some bearing upon the fracture of rails, but not nearly so much as the temperature of the rail itself. With the same bearings of the same elasticity, a rail of 0 temperature will break with one-fourth the blows required at 70°.

TABLE III.

*Record of Nick Bending Tests at Different Temperatures*

| Test No.. | Mark on Bars and Material. | Temperature Deg F | Per Cent Crystalline. | Per Cent Fib. |
|---|---|---|---|---|
| 12 | ¾ in. Bd. Steel. | 10 | 100, Fine Grain. | |
| 13 | ¾ " " | 12 | 100, " | |
| 15 | ¾ " " | 12 | 100, " | |
| 14 | ¾ " " | 80 | 100, Granular. | |
| 20 | ¾ " " | 60 | 100, " | |
| 21 | ¾ " " | 60 | 100, " | |
| 22 | ¾ " " | 60 | 100, " | |
| 23 | ¾ " " | 60 | 100, " | |
| 24 | 1 " " | 60 | 100, " | |
| 25 | 1 " " | 60 | 100, " | |
| 26 | 1 " " | 60 | 100, " | |
| 27 | 1 " " | 60 | 100, " | |
| 28 | 1 " " | 8 | 100, Coarse Grain. | |
| 29 | 1 " " | 8 | 100, " | |
| 1 | 1 " " | 0 | 100, Crystalline. | |
| 30 | ¾ " Iron | 60 | | 100 |
| 31 | ¾ " " | 60 | | 100 |
| 8 | ¾ " " | 80 | | 100 |
| 5 | ¾ " " | 60 | | 100 |
| 6 | ¾ " " | 60 | | 100 |
| 10 | ¾ " " | 10 | 25, Cryst. | 75 |
| 11 | ¾ " " | 0 | 40, " | 60 |
| 32 | 1 " " | 60 | | 100 |
| 3 | 1 " " | 60 | | 100 |
| 9 | 1 " " | 60 | | 100 |
| 4 | 1 " " | 60 | | 100 |
| 7 | 1 " " | 0 | 60 Cryst. | 40 |
| 16 | 4½x4¼ " | 60 | | 100 |
| 16 | 4½x4¼ " | 12 | 25, Cryst. | 75 |
| 17 | 4½x4¼ " | 12 | 30, " | 70 |
| 32 | 4½x4¼ " | 12 | 30, " | 70 |
| 33 | 4½x4¼ " | 60 | | 100 |
| 34 | 4½x4¼ " | 60 | | 100 |
| 35 | 4½x4¼ " | 60 | | 100 |
| 36 | 4½x4¼ " | 60 | | 100 |
| 18 | 4½x4¼ Steel | 60 | 100, Granular. | 100 |
| 18 | 4½x4¼ " | 12 | 100, " | |
| 19 | 4½x4¼ " | 12 | 100, " | |

Record of Nick Bending Tests of 1 inch U-Bolt iron, by Mr. CLARK FISHER, specimens sent to M. I. BECKER

| | | | | | | |
|---|---|---|---|---|---|---|
| No. 1. | 1 in. Bd. Iron. | 22 | 85, Cryst. | 70° F. | 15 | Gra. |
| " 2. | 1 " " | 22 | 100, " | 70° F. | 12 | Cry. |
| " 3. | 1 " " | 22 | 85, " | 70° F. | 100 | Fib. |
| " 4. | 1 " " | 22 | 25, " | 70° F. | 95 | " |
| " 5. | 1 " " | 22 | 90, " | | 100 | " |
| " 6. | 1 " " | 22 | 95, " | 70° F. | 100 | " |

The iron used by Mr. FISHER for U-bolts is of the best ductile quality.

TABLE IV.

*Record of Cold Bending Tests at Different Temperatures.*

| Test No. | Marks on Bars and Material. | Temper. Deg. F | Angle of Bend. Degrees. | Around What Diamt'r |
|---|---|---|---|---|
| 12 | ¾ in. Bd. Steel. | 10 | 140 | 2 in. Pin. |
| 13 | ¾ " " | 12 | 140 | 2 " |
| 15 | ¾ " " | 12 | 150 | 2 " |
| 14 | ¾ " " | 80 | on itself. | |
| 20 | ¾ " " | 60 | 180 | on itself. |
| 21 | ¾ " " | 60 | 180 | " |
| 22 | ¾ " " | 60 | 180 | " |
| 23 | ¾ " " | 60 | 180 | " |
| 24 | 1 " " | 60 | 180 | " |
| 25 | 1 " " | 60 | 180 | " |
| 26 | 1 " " | 60 | 180 | " |
| 27 | 1 " " | 60 | 180 | " |
| 28 | 1 " St. Pressure applied very gradually. | 8 | 130 | 2 in. Pin. |
| 29 | 1 " Steel. | 8 | 180 | 2 " |
| 1 | 1 " " | 0 | 180 | 2 " |
| 30 | ¾ " Iron. | 60 | 180 | 2 " |
| 31 | ¾ " " | 60 | 180 | 2 " |
| 8 | ¾ " " | 80 | 180 | 2 " |
| 5 | ¾ " " | 60 | 180 | 2 " |
| 6 | ¾ " " | 60 | 180 | 2 " |
| 10 | ¾ " " | 10 | 150 | 2 " |
| 11 | ¾ " " | 0 | 130 | 2 " |
| 32 | 1 " " | 60 | 180 | 2 " |
| 3 | 1 " " | 60 | 180 | 2 " |
| 9 | 1 " " | 60 | 180 | 2 " |
| 4 | 1 " " | 60 | 180 | 2 " |
| 7 | 1 " " | 0 | 160 | 2 " |
| 16 | 4½×1¼ in. Bd. Iron. | 60 | 180 | 2 " |
| 16 | 4½×1¼ " " | 12 | 160 | 2 " |
| 17 | 4½×1¼ " I. Pressure applied very gradually. | 12 | 180 | 2 " |
| 18 | 4½×1¼ " Steel. | 60 | 180 | on itself. |
| 18 | 4½×1¼ " " | 12 | 135 | 2 in. Pin. |
| 19 | 4½×1¼ " " | 12 | 115 | 2 " |

I have the record of 99 steel rails broken last winter, and in that 99 none are reported when the temperature was above 44°; five (5) being found when temperature was 44°, but as two days previous the temperature was 8°, and the day before that at

zero, I think these rails were really broken two days before being found. Of the 99 rails, 32 were broken when temperature was between 2° and 5°, 44 below 8°, 54 below 22°, 83 below 32°, and 99 below 4°.

Seventy-nine were found within the two days following, cold snap ranging from 2° to 30° below zero.

From the above record the effect of temperature upon railway breakage is seen to be a factor of importance, whether due to frozen ballast or frozen rails.

TABLE V.

*Drop-Ball Tests.*—Weight of ball, 96 lbs.; distance between supports, 10½ ins.; drop of ball, 10 ft., except where specially designated. Size of each trial, 4½ × ¾ × 18 ins. Each bar nicked by being cut ¾ in. deep with a planer on each side of the wide faces of the bare.

| Test No. | 2 | 3 | 12 | 11 | 8 | 1 | 9 | 4 | 10 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stamp on Bar. | 0°–16 | 0°–17 | H 17 | E 16 | C 17 | 32°–17 | D 17 | 62°–16 | K 17 | 16 F | 0–17 | A 16 |
| No. of Blows. | 2 | 3 | 2 | 3 | 2 | 5 Full. 5 Gran'r. | 15 | 21 | 16 | 2 | 3 | 6 |
| Material. | Iron. | Iron. | Iron. | Iron. | Iron. | Iron. | Iron. | Iron. | Iron. | Iron. | Iron. | Iron. |
| Temp'ure Fahren't. | 0° | 0° | 0° | 4° | 4° | 32° | 42° | 62° | 82° | 10° | 52° | 70° |
| Fracture. | Comp'te. 70 % Cry. 30 % Fib. | Comp'te. 70 % Cry. 30 % Fib. | Comp'te. 50 % Cry. 50 % Fib. | Comp'te. 60 % Cry. 40 % Fib. | Comp'te. 60 % Cry. 40 % Fib. | Comp'te. 25 % Cry. 75 % Fib. | Incom'te. 100 % Fibrous. | Incom'te. 100 % Fibrous. | Com'te. 100 % Fibrous. | Comp'te. 70 % Cry. 30 % Fib. | Comp'te. 25 % Cry. 10 % Gran. 65 % Fib. | Comp'te. 100 % Fibrous. |

| Blow No. | *Deflections in Fractions of an Inch.* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ⅜ | ⅜ | ⅜ | ¾ | 2 | ⅜ | ⅜ | ⅜ | ⅜ | ⅜ | ¼ x | ⅛ x |
| 2 | .. | ⅜ | 1⅛ | .. | .. | ⅜ | ⅜ | ⅜ | ⅜ | .... | 1— | ⅜— |
| 3 | .. | .. | .. | .. | 1⅛ | ⅜ | ⅜ | 1⅜ | ⅜ | .... | ..... | ⅜ x |
| 4 | .. | .. | .. | .. | 1⅜ | ⅜ | ⅜ | 1⅜ | ⅜ | .... | ..... | ⅜— |
| 5 | .. | .. | .. | .. | .. | 1⅜ | 1 | 2⅛ | ⅜ | .... | ..... | 1 x |
| 6 | .. | .. | .. | .. | .. | 1⅝ | 1⅛ | 2⅜ | ⅜ | .... | ..... | ..... |
| 7 | .. | .. | .. | .. | .. | 2⅜ | 1⅜ | 3⅜ | ⅜ | .... | ..... | ..... |
| 8 | .. | .. | .. | .. | .. | 3 | 1⅝ | 4 | ⅜ | .... | ..... | ..... |
| 9 | .. | .. | .. | .. | .. | 3⅛ | 2⅛ | 4⅛ | ⅜ | .... | ..... | ..... |
| 10 | .. | .. | .. | .. | .. | 4⅛ | 2⅜ | 4⅜ | ⅜ | .... | ..... | ..... |
| 11 | .. | .. | .. | .. | .. | 4⅜ | 3 | 5 | ⅜ | .... | ..... | ..... |
| 12 | .. | .. | .. | .. | .. | 5⅛ | 3⅛ | 6⅛ x | ⅜ | .... | ..... | ..... |
| 13 | .. | .. | .. | .. | .. | 5⅜ | 4⅛ | 6⅛— | ⅜ | .... | ..... | ..... |
| 14 | .. | .. | .. | .. | .. | 6⅛ | 4⅜ | 6⅜ x | ⅜ | .... | ..... | ..... |
| 15 | .. | .. | .. | .. | .. | 7 | 5 | 7⅛— | ⅜ | .... | ..... | ..... |
| 16 | .. | .. | .. | .. | .. | ..... | 5⅛ | ..... | ⅜ | .... | ..... | ..... |
| 17 | .. | .. | .. | .. | .. | ..... | 5⅜ | ..... | ⅜ | .... | ..... | ..... |
| 18 | .. | .. | .. | .. | .. | ..... | 6⅛ | ..... | ⅜ | .... | ..... | ..... |
| 19 | .. | .. | .. | .. | .. | ..... | 6⅜ | ..... | ⅜ | .... | ..... | ..... |
| 20 | .. | .. | .. | .. | .. | ..... | 6⅜ | ..... | ⅜ | .... | ..... | ..... |
| 21 | .. | .. | .. | .. | .. | ..... | 6⅜ | ..... | ⅜ | .... | ..... | ..... |

NOTE.—In tests Nos. 5, 6 and 7 the test pieces were reversed after every blow; this after the first blow increased the distance between bearings from 10½ ins. (the distance between bearings for all other tests) to about 17 ins., as the test piece would rest upon its ends when reversed.

No. 16, after the twelfth blow, was also reversed, so as to cause a complete rupture.

As stated in the beginning more tests are wanted, and indeed seem to become necessary to a full and definite knowledge of the effects of low temperature upon iron and steel, and if this crude paper upon this subject is instrumental in bringing such tests and investigation about, the end of the writer will be obtained.

The following questions are suggested to me by the result of my tests, and I think a discussion based upon them will bring out all there is in the matter generally:

1. Should a temperature be prescribed in specifications at which the nicked bending test for texture shall be made, or at which the iron should show good fibrous iron.

2. Is the present method of testing iron for ultimate strength, elastic limit and elongation calculated to secure the best iron for bridge work.

3. Should not an impact test by drop weight be added to the tests.

4. Is it safe to run trains over iron bridges at high speed when the temperature is low, say 15° above, and if not, what should be the maximum speed at such temperature?

I wish to acknowledge and give credit to Mr. A. E. HUNT for the aid and assistance given me in these tests, also services of Mr. F. BERESFORD, C. E., of Cincinnati.

## The Water-Works of Kansas City.

BY G. W. PEARSONS, CHF. ENG. NATIONAL W. W. CO.

*Continued from page 380.*

(TO BE CONTINUED.)

*The Intake Crib.*—A row of piles was driven to guard the location chosen, and the place of the crib cleared of stone by a diver, leaving the willow mattress intact. Two rows of piles were now driven from the guard piles to the shore; their tops secured to large stringers which were placed level, as a guide to the soundings taken for fitting the longitudinal bed timbers, which were cut to fit the mattress, adjusted to place by the diver and heavily loaded, one being placed at a time. From a careful survey of these after being placed, a grillage was built forming the bottom of the inlet caisson, sunk to place and heavily bolted at every intersection. The caisson to within 2 ft. of low water mark is built of oak and yellow pine, the sides 16 in. thick, and so sunk over the bottom as to lock with it. On the river side it has openings for the admission of water, and on the shore side an opening for the wrought-iron end of the syphon, which is 3×5 ft. The remainder of the intake will be a heavy stone pier; the river side openings extending to high water. The interior well will contain gates and screens to admit water at any height desired, and to guard the pumping; access to the pier will be by a foot bridge.

The lower left hand figure, Plate 7, shows longitudinal bed timbers, grillage and piles. The next the intake crib or casson, shown also in end and side elevation in other figures. The next shows the grillage resting on the crib and piles for the support of the pier.

*The Syphon.*—Seventy-five feet of the river end is made of wrought-iron. When the mattress was cut for its passage, it was rebuilt around it, and the rock covering increased in depth; it is continued to the well in the center of the pump house with 42-in cast-iron pipe, with ordinary lead joints. On account of the difficulty in trenching in the unstable alluvial soil, the rise was made mostly at the river. The rest of the line rising but 6 in. in 100 ft., the bottom of the trench was made 6 ft. wide, and cross planked to guard against uneven settlement of the pipe. The whole length of the syphon is 745 ft.; its center 10 ft. above low water mark. To guard against flooding the basement in high water, a valve is placed near the well for the same purpose. The basement is everywhere founded on concrete; nowhere less than 3 ft. thick. It was intended to use an air pump in connection with the syphon, but a steam ejector was first used for convenience; on trial the vacuum remained unbroken for a week, and only needed daily renewal when the pumps were lifting 1,000,000 galls. per hour.

*Settling Basins.*—The location determined and the form adopted, they are built on the alluvial bottom lands below the bluff; elevations of land 27 ft. above datum; top of banks 50 ft. At the bottom the outer banks are 74 ft. wide; at the top of the ice wall, 13½; outer slope, 1½ to 1; the river side guarded with rip-rap; the rest having a light retaining wall at the bottom. Inside slopes 2 to 1; the adjacent bluff being of heavy retentive clay, was used for the embankments. The bottom of all the basins were covered with 2 ft. of the same in thin layers, dragged and rolled. These and the slopes were covered with concrete; covered with a smooth coat of cement mortar; its thickness on the bottom is 4 ins., on the slopes, 5 ins. The interior walls rest on a grillage of 8×10 timbers 14 ft. long. They are spaced 10 ins apart; their ends rest on 10×10 longitudional timbers. the whole bedded in concrete. The section of this wall, Plate 8, is erroneous in representing the lower two courses of masonry, as wood.

Two conduits, 3 ft. ×6 ft. 3 in. are built in each of the interior and part of the east wall, which is built as a fall wall to admit extending the basins on this side. The bottom of the center basins has a 10 per cent. slope, the others from 5 per cent. to 3 per cent.; the depth of water varies from 20 to 30 ft., except the east end of the center basin, which is shallower. Their combined capacity is 60,000,000 galls.

*Normal Water Flow.*—Water enters the center basin through a spreading inlet near the bottom at the center of the circular end; this prevents the formation of currents, and when the water has risen above the inlet, it appears to be at rest, Passing slowly to the east end of the basin it flows in a thin sheet over a weir 100 ft. wide, and through openings in the wall to the upper conduit; from this it descends to the lower conduit and enters the north basin at the bottom, as shown in Fig. 1, Plate 8; it leaves this at the top, enters the west basin at the bottom in the same manner, and continuing its flow through the south basin, from there flows to the tank at Kaw Point. At this station a part is used for the supply of the area already described, and the rest flows to the first works, where the settling basins become the storage basins for the new supply. The 36-in. main has a capacity of over 16,000,000 galls. to Kaw Point. When the call at this point reduces the flow to the first works too much, means are provided for accelerating it by pumping.

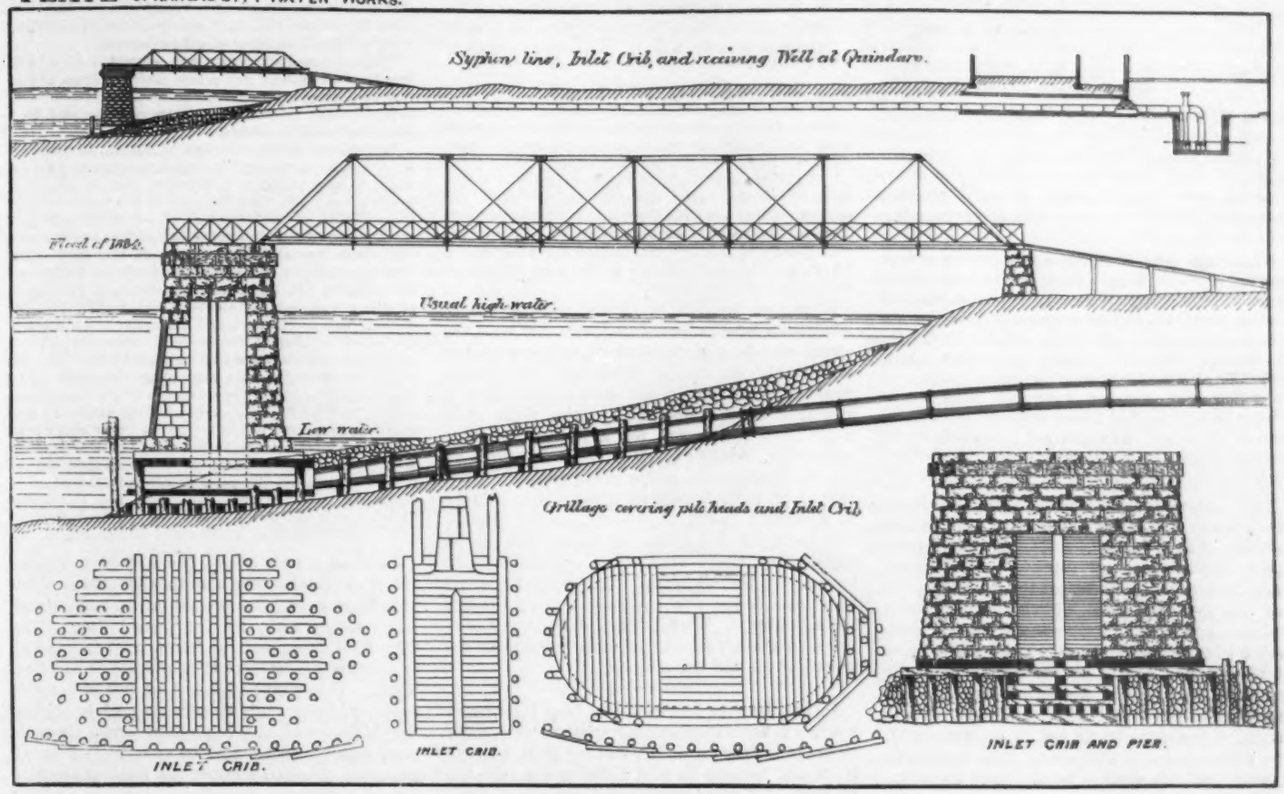
*Cleaning the Basins.*—The Missouri carrying an average of about 2 cu. yds. of sediment for 1,000,000 galls. requires convenient means for its removal. About 90% of this will descend in the first basin. To clean this the stop valve in the inlet is closed; the water then rises through a vertical branch and overflow into the upper conduit, gate No. 4 in the upper conduit being closed, preventing its return to the center basin; this is shut out while the action of the other basins is uninterrupted. The surplus water is now drawn back to the pumps, then the outlet (No. 18) being opened, the mud is run back to the river. The stop valve can be opened and water let in from the east end, and to these are added the use of hose streams from the wells, insuring the quick and easy handling of the sediment. The other basins are cleaned in a similar manner. The water flow in each case being shown by the small diagrams in Plate 8.

(TO BE CONTINUED.)

MR. EDWARD WESTON, the electrician, is reported as suggesting a new offensive weapon to be used against the crew of an ironclad. This is a shell filled with nitrate of amyl, the fumes of which will quickly cause insensibility in anyone breathing them, and in effect are equivalent to a temporary paralytic stroke. It is cheap and plentiful, and a few gallons would do the work, says Mr. WESTON. We must confess we are not chemist enough to know what nitrate of amyl is, but a scheme by which the enemy's crew could be quietly put to sleep until their ship could be towed into port would be more merciful and quite as effective as an eternal sleep brought about through the medium of a half-ton of dynamite exploded among them. It would make less of a mess and leave the ship worth something in prize money.

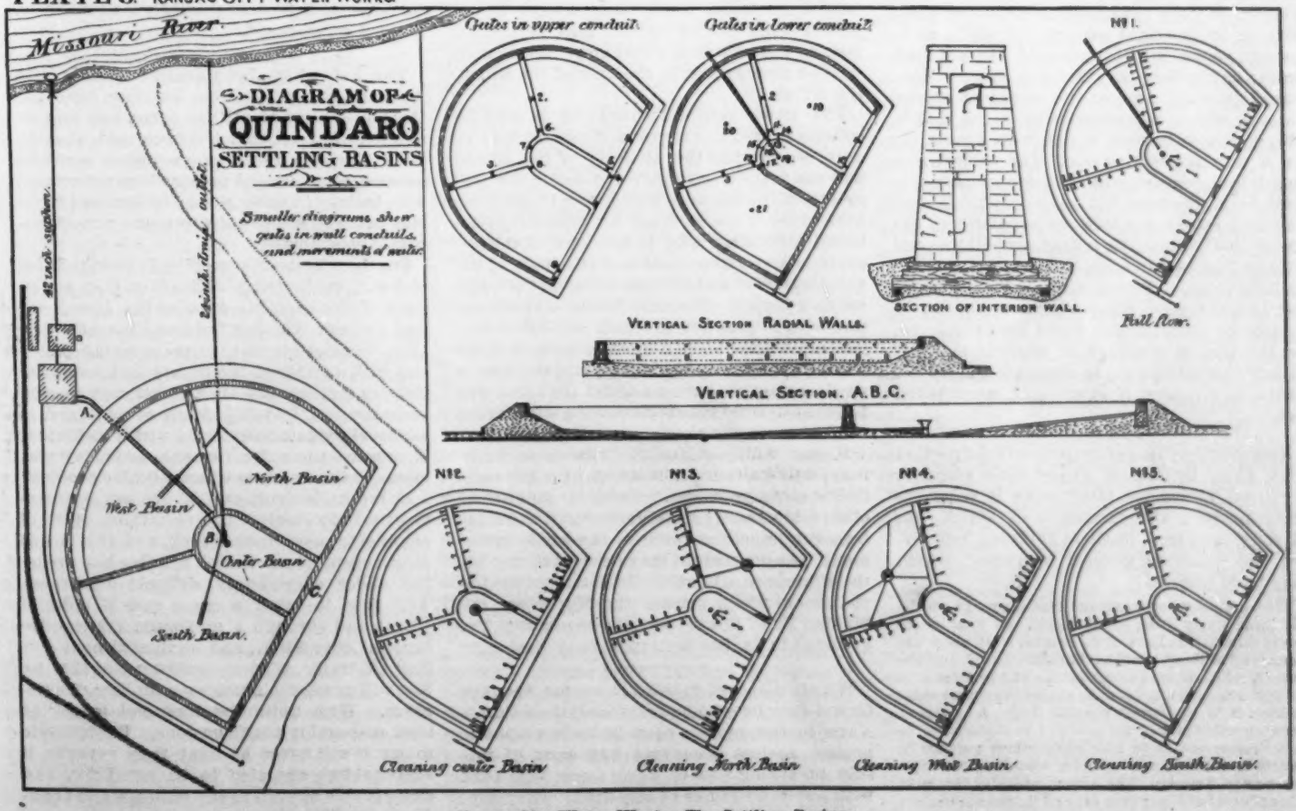
ONE advantage of steel ties was demonstrated in the late washout, from the bursting of a water spout on the Mexican Central R. R. The *Financier*, of Mexico, says that both wood and steel ties were laid on the section affected, and while the first were washed away and the track badly torn up; on the part laid with steel ties only the gravel ballast was washed out all the rest of the roadway was intact.

PLATE 7. KANSAS CITY WATER WORKS.


Syphon line, Inlet Crib, and receiving Well at Quindaro.
Flood of 1844.
Usual high water.
Low water.
Grillage covering pile heads and Inlet Crib.
INLET CRIB.
INLET CRIB.
INLET CRIB AND PIER.

Kansas City Water Works: The Intake Cribs, Etc.

PLATE 8. KANSAS CITY WATER WORKS.




Kansas City Water Works: The Settling Basins.

# ENGINEERING NEWS

TRIBUNE BUILDING, NEW YORK.

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D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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THE instructions issued by Chief Engineer MENOCAL to Sub-Chief Engineer PEARY in immediate charge of the surveys for the Nicaragua Canal, are very minute and contemplate first the survey by all the parties of the north-eastern section of the canal, with special attention to Greytown harbor, estimated to take three month's time, when most of the parties are to be removed over to the comparatively short western section. The important detail of boring to ascertain the nature of the material is not to be neglected. The present idea is that six to nine months in all will cover the work of preliminary location, enough to base tolerably exact estimates on, which with five parties in the field ought to suffice if they are skillfully and energetically handled. It ought to be possible with that amount of work to arrive at very fair approximation to the total cost of the work, as so large a part of it will consists of lake and slack water navigation, or 129 miles against 40 of canal proper. Among the works of special interest will be a proposed single lock of 53 ft. lift, of course in rock, which would certainly be a very interesting one. The project as a whole is undoubtedly the best for an inter-oceanic canal, the total lift being only 110 ft., and the *ignis fatuus* of a lockless canal, which has led M. de LESSEPS so far astray, not being an end of any real importance, if the locks are well designed and provided with hydraulic plant to handle vessels. Supposing a whole day to be lost by them, which could very rarely be, what is that in a voyage of weeks or months? It is not probable that 10 cents a ton more toll could be obtained if every lock were taken out.

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THE company issued a circular in connection with their invitations to see their engineer corps off, giving the latest news in regard to their project, the substance of which has already appeared in these columns, but giving the following general summary, which may be of interest:

"The proposed route extends from Greytown, on the Carribean sea, to Brito, on the Pacific. Its total length is 169.8 miles. The Lake of Nicaragua, 110 ft. above the mean level of the sea, will be the summit level, and the rivers flowing into and from the lake will be utilized to the best advantage, in order to reduce the actual canal excavation to the lowest possible limit. A system of locks on either side of the lake will be constructed, of such dimensions as to give commodious passage to vessels of the size now used for ocean navigation in Europe and America. The bottom width of the forty miles of canal will vary from 80 to 120 ft., and the surface width from 80 to 268 ft., with a depth of from 38 to 50 ft., but the 129 miles of river and lake will form a waterway safe for rapid navigation, with ample depth throughout. The total cost is estimated at $64,036,197.

"The following table of tonnage that would make use of the canal today if it were open, is based on the reports of the Bureau of Statistics, United States Treasury Department, and, of course, is prepared from official data:

| | |
|---|---|
| Tonnage in 1879 | 2,771,886 |
| Tonnage in 1885 | 4,252,434 |
| Increase in six years (tons) | 1,480,548 |

"At the same rate of increase the tonnage for 1892, the possible date of completion of the Nicaragua canal, would be 6,506,214 tons, which, at $2.50 per ton, (the Suez canal tolls) would return a gross revenue of $16,265,535.00.

"The development of our Pacific States would, it is believed, be very rapid from the day the canal was opened. That such a facility would quickly and largely increase the traffic is shown by the experience of the Suez canal, which in 1870 transported a net tonnage of 436,609, at tolls of $1,031,865, and in 1883 a net tonnage of 5,775,861, at tolls of $13,702,413."

It is the fashion to throw cold water on American enterprises of this sort, but that the canal can be put through at reasonable cost and would be highly advantageous to this country we have no doubt, and some moderate governmental assistance, in the form of a guarantee of interest for a limited term or otherwise, would certainly seem justified by the circumstances, and a good use for a fraction of our troublesome surplus revenue. There is a certain equity in doing this, for besides the value of the canal to those who use it themselves, there would be a certain decided benefit to the whole people. Without some such assistance the chances of the project seem doubtful. We believe the canal will pay, but we certainly should not believe it $64,000,000 worth, if we had the money.

---

MAYOR HEWITT has with the best intentions made a great architectural mistake in regard to his plans for an enlarged City Hall, and we trust and believe he will have the manliness to come out and admit and correct it. His main idea and purpose may have been right, but in attempting to fix the best architectural method of carrying out his plans, he has fallen into those errors which may always be expected when the shoemaker goes beyond his last, as was shown in a still more conspicuous way six months ago in the case of the Brooklyn bridge.

The letter signed PHILO-ARTIS in another column makes this too clear for doubt, and we only regret that the modesty of the author will not permit us to give the letter the still greater force which it would have if signed by him, since it comes from an engineer of national reputation who is also one of the few engineers who have combined the study of the artistic side of architecture with that of engineering proper. Few men in our community are better qualified to form an intelligent judgment upon such a matter, as indeed his letter bears internal evidence, and the case is so clear that we have no doubt his letter will have the desired effect—to cause a withdrawal of the too hastily chosen ground plans.

We say "Mayor HEWITT" has made a mistake, well knowing that nominally he must divide the responsibility with a number of others, but really, as we understand it, he has been the impelling force to the whole movement. The movement may be a good one, but the attempt to arbitrarily fix details of the improvement which neither the Mayor nor the Sinking Fund Commissioners are in any way qualified to fix, has been most improper.

---

WE are disposed to think, however, that the Grand Jury have come still nearer than PHILO-ARTIS to the proper plan in their emphatic protest against occupying any more of this sole breathing spot of down town New York with public buildings of any kind. They say:

"The Grand Jurors, in closing their labors for the present term, feel it to be their duty to protest against the plan proposed by the Commissioners of the Sinking Fund for placing additional buildings upon the City Hall Park, a place already encumbered by several buildings which should be elsewhere provided for. The City Hall Park contains about eight acres of land, and with the present buildings and those proposed, about one-half the whole area would be covered.

"The proposed structures will extend to about fifty feet from Broadway and a less distance from Tryon-row, and practically cut up the park into three small sections, thus substantially destroying the park as a breathing place for public use.

"The widening and extension of Elm st., an improvement long and urgently demanded, and now, we assume, about to be accomplished, will turn into Chambers st. a volume of traffic that can only be accommodated by the widening of that street on its southerly side, and the removal of the old engine house that has too long disfigured the northeast corner of the park. The rapidly increasing traffic over the Brooklyn Bridge and the elevated roads imperatively demands very much enlarged and appropriate terminal facilities on the easterly side of the park and the material widening of the street in front of the bridge. This of itself will necessitate the early removal of the old Hall of Records which has long been an eyesore to the public and a disgrace to the city. The unfitness of this building as a receptacle for the important archives of the city and the titles to all city property has for many years been a reproach to the public authorities. These facts being conceded, as they must be by every thinking citizen, it is manifest that the park is not a suitable place to encumber with additional buildings, and the Grand Jurors firmly but respectfully protest against anything of the kind being done which tends to that end."

In what is said about the Brooklyn Bridge this is especially true, and there is still another reason why the plan should not be carried out, not touched upon by the Grand Jury: The City Hall is one of the most interesting and creditable architectural remnants of old New York. It is well to preserve a few at least of such buildings. It is large enough to shelter the Mayor and city legislature, and there is land enough to be had in the vicinity at no excessive price to shelter the bulk of the city officials without trenching further on this little oasis in the desert of down town New York. Nevertheless, there is an argument on the other side, we admit, but if anything is to be done let it be done properly and worthily, and not as proposed.

---

THE Fates have been dealing harshly with M. de LESSEPS at Panama for some time, but the sorest blow of all has come, and he now admits, after all that has been said, that he must abandon his long cherished sea-level scheme, and "for the present" open the canal with locks. In other words, he has had to decide between a colossal wreck and a most desperate compromise.

For the scheme now proposed presents financial and engineering difficulties that are almost, if not quite, as great as the abandoned first project. To open the canal to traffic with 15 ft. of water—as that seems to be the plan—and with a series of temporary locks over the Culebra section, and then to attempt to complete the canal to full depth of 29 ft. and to sea-level without interfering with a traffic that is counted upon for revenue, adds new elements to an already most complicated problem.

If report be true, and it has not been authoritatively denied, the remaining 14 ft. of channel in most cases is rock, and this means most expensive submarine blasting and dredging under exceedingly difficult conditions. And then to lower a canal over 15 miles of length and through a maximum vertical distance of over 300 ft., and do this without cutting off traffic, is an engineering feat that we fear will prove too much even for French engineers. With unlimited time and money at their disposal it might be done. But it is safe to say it will never be done from revenue, if shareholders are also to be cared for, and there is an end even to the patience and confidence of a Frenchman.

While the final deepening of the Suez canal

and its completion after it was opened to traffic, is continually held out as a precedent, every engineer connected with the Panama canal knows that the cases are in nowise parallel. At Suez, sand and mud were to be dealt with and the water level was a constant; the Panama project, as shown above, will be quite another problem.

Now too, M. de LESSEPS calls for a sum of $113,000,000 to finish the canal even on this compromise basis; this will make the total debt nearly $500,000,000, and the most sanguine estimate of traffic will not permit an excess over the company obligations that would be disposable for improvement out of earnings. In short, if the Panama canal is ever opened with locks, it will never be a sea-level canal in our generation, if at all.

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EVERYBODY knows that the year of 1887 has been one of great industrial activity in the South. Cities that a few years ago were dull, provincial, and behind the times are now booming with an energy that rivals the frontier towns of the West. The South has awakened to a realization of its abundant natural resources, and its inhabitants have set to work to develop its coal fields and iron mines, to open up for settlement and cultivation its vast tracts of fertile lands, to establish mills and factories, and in general to demonstrate that the old plantation régime is at an end. It is well known, too, that preceding and accompanying this wave of busy enterprise there has been a large amount of railway construction, the statistics of which are a valuable indication of the present condition and probable future of Southern industries. Map No. 4 of our construction series, issued as a supplement to the present number, with the complete list accompanying it, is of especial value therefore, to all who are interested in Southern development; as it shows at a glance the centers of greatest activity, as well as those which have as yet hardly felt the new spirit of enterprise.

To everyone interested in Southern railroads or in railroad construction, it is needless to say that this information if correct must be of especial value. That the statistics to be obtained from the current newspaper items are so vague and erroneous as to be wholly unreliable, we can testify from experience; and while from the nature of the case absolute accuracy is unattainable, we can say of our own record that it is as correct as wide correspondence and the cooperation of officers of the leading Southern railroads could make it.

The map and list, however, are necessarily confined to the briefest possible data. The history of a railroad line from the time of its first conception as an idea in the brain of some enterprising capitalist or railroad or real estate operator, to the day when it is opened for traffic, is almost invariably a checkered one. Seasons of financial depression, disagreements among the promotors, shrewd moves to obtain local aid, are all causes which are prone to operate and give the enterprise its ups and downs. Necessarily in our condensed summary we have had to class together lines of widely different status, and it is only in our weekly report of the railroad situation that we can attempt to do full justice to all the various schemes and record their progress and changes.

In our next issue, however, we shall supplement the data given on our map and list by an explanation of the progress and status of some of the principal Southern systems and a description of the character and backing of some of the principal schemes now under way. At that time also, we shall hope to do better justice to the magnificent industrial prosperity of which the South is capable than is possible in this brief note.

### The Effect of Cold on Iron and Steel.

We trust we need do no more than call the attention of our readers to the very important paper by Mr. JOSEPH RAMSEY before the Engineer's Society of Western Pennsylvania, which appears in full, with the first evening's discussion, in another column, giving new and valuable experimental evidence in respect to that much disputed question, the effect of cold on the strength of iron and steel. Mr. RAMSEY's results directly controvert the generally received opinion that there is no such effect, but he certainly presents evidence of a very weighty character, and the paper should be, and we have no doubt will be, read with care by all engineers who are concerned with the question of the strength of metals under strain and impact, in other words by engineers of all kinds.

The fact that there is an apparent conflict of experimental evidence should not lead us to conclude that there is one in fact. There is nothing that will lie like experiments if they are improperly interpreted, and there is no task of the scientist more difficult, or more frequently ill done, than the interpretation of experiments. What is needed therefore, and what certainly must be obtainable, is a theory consistent with *all* the experimental evidence and inconsistent with none. When we have that we shall have the truth. By rejecting either half of our evidence, because of an apparent conflict, we are quite certain to be in error.

As we stated at some length in our issue for Feb. 19, 1887, we have become satisfied from experimental evidence quite apart from Mr. RAMSEY'S (for we had not then heard of his tests, although some of them had been made) that the popular belief that cold did reduce the effective strength of iron and steel was the correct one, and that the burden of scientific evidence, which undoubtedly makes for the contrary view, was incorrect. This evidence was the record *by days* of the reported rail breakages on a long line of road, which was plotted on a diagram in comparison with the temperature of each day. The coincidences between the two lines are startling to any one who stops for a moment to think what they mean and what they prove, and they appear to us to leave no room for doubt that the resisting strength of rails at least does vary almost directly with the fall of temperature, and if of rails, why not other kinds of iron and steel as well?

The case stands thus: Such a test is on an immense scale, covering perhaps 100,000 rails for 100 days of varying temperature. No laboratory tests are on any such scale as this. The general fact that there is a vastly greater number of rail breakages in winter than in summer—so much greater that the summer breakages sink into insignificance by comparison—is questioned by no one, and established beyond all doubt. It is claimed and believed by many, however, that this is in no way due to the rails being weakened by the cold but simply to the fact that the roadbed is frozen solid, so as to have an anvil-like effect, and is also rough from heaving by the frost, so that these two causes together necessarily increase breakages.

This is a plausible theory, and so long as we have nothing more than the aggregate of winter and summer breakages to go by, it is an ample *prima facie* explanation of the contrast, especially as it is supported by the laboratory tests which seem to show that the temperature of the air has no effect on the strength of metals. But it is evident that if this theory be correct *the fractures should remain substantially constant while the condition of the track remains the same*, regardless of the temperature.

But the records we refer to, and which we hope shortly to present, show exactly the contrary of this. Early in the winter the track freezes up, and in our Northern winters, as every one knows, it remains frozen for weeks and months together. Even when there is a thaw on the surface it rarely penetrates beneath the ties until the end of the winter has come, and for weeks together the temperature is so low that there is not even a thaw on the surface. If it does thaw beneath the ties it does so but partially and the track becomes for the time even rougher than before.

Nor does ice grow harder or softer with the temperature, after it is once thoroughly frozen through, so long as it continues below 32° Fahr., so that there is a long period in every winter when the condition of the track and roadbed remains sensibly constant. If, therefore, during such a period, we find that the rail breakages remain by no means constant, but fluctuate from day to day in almost direct ratio with the temperature, as it varies up and down between the limits of −20° and +30°, Fahr., so that at the higher temperature there will be very few fractures reported, and at the lower temperature a very large number, and that this contrast will continue when the temperature rises for a day or two to 50° or 60° Fahr., although we well know that it cannot thaw the track appreciably in that time (or if it did, would only make it rougher) what is the inevitable conclusion?

Plainly that temperature as such, all other conditions being constant, does have a very important influence upon the fracture, and we are unable to imagine any kind of scientific test which could be more conclusive. It is to be remembered that the men who make the tests are absolutely uninfluenced by any prejudice. They do not even know a test is going on, but simply report each day what they find, and as the aggregate is made up from inspections by a hundred or so different men the "personal equation" is almost eliminated. One man may have a habit of inspecting more closely in cold weather, when his experience teaches him there is more danger of fractures, but then another will do less in cold weather than in warmer, because of bodily discomfort, so that the average is about the same.

It may indeed be assumed that all inspectors would tend to be more vigilant in very cold weather, but we do not think that assumption is tenable. The inspection is purely a matter of routine, made at certain hours every day, and as respects broken rails, of very monotonous routine, since comparatively few are discoverered by any one man at any one time. We can perceive no reason why there should be any material difference in vigilance from the weather, except that the duty would be more likely to be perfunctorily discharged in very cold weather, for the reason suggested. In spite of this the results are as they are, and they appear to us to be proof of a high order substantiating the essential correctness of Mr. RAMSAY'S conclusions.

We have purposely avoided any analysis of the latter for the reason that the paper is a concise one as it is, and demands reading in full. At a later date we may have something to say as to the conclusions which are warranted by the evidence, but at present we merely wish to call attention to the fact that there is the strongest kind of outside evidence of the correctness of his conclusions.

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IT is said that the President in his approaching message will recommend Government aid to the Nicaragua canal enterprise. We earnestly hope this is true, provided it is merely *aid* and not National assumption of the work,

### Water-Works Construction—1887.

The present activity of the water supply industry in the United States is shown by the large number of private corporations which have been organized to build water-works in 1887. At the beginning of the year, 1,402 towns had water-works. Of the 1,219 towns reporting, the works in 544 were controlled by the public authorities, and in 675 by private corporations. Since Jan. 1, 98 companies have been organized by individuals to supply water to towns, 3 large irrigation companies have been organized in the west, and 13 companies, who, besides water, supply gas, electric light, or deal in land. Of the 98 companies, the capital stock of but 68 is reported, a total in round numbers of $7,250,000, or an average of about $106,300. On this basis it is safe to say that $9,000,000 are controlled by these 98 companies, while the three irrigation companies have $4,000,000 capital, and the 13 other companies named, about $13,500,000. These figures are very significant. The companies organized will bring water to 100 towns, many of which must have continued without an adequate supply for many years had it not been for the organized capital of enterprising men.

The cause for so large a number of new water-works companies has been two-fold. First, the people's demand for a plentiful supply of water for both domestic purposes and fire protection, and second, the reasonable and easy terms upon which the companies have offered to meet this demand.

It is interesting to note the distribution of these companies over the United States. Following the sub-divisions used in our "Construction News," under railroads, we have 43 companies formed in the States East of Chicago, 18 in the Southern, 15 in the Northwestern, 14 in the Southwestern, and 8 in the Rocky Mountain and Pacific States. As said above, we are able to give the capital of only 68 companies. Of these, 29 are in the States East of Chicago, and have a total capital of $1,956,000, or an average of about $72,400 each. In the South, 12 companies have a capital of $915,000, or an average of $96,250 each. In the Northwest, 12 companies have a capital of $2,525,000, or an average of $210,400 each. In the Southwest, 10 companies have a capital of $940,000, or an average of $94,000 each. In the Rocky Mountain and Pacific States 9 companies have a capital of $895,000, or an average of $128,000 each.

The cause for the greater number of companies in the East, and their smaller amount of capital for each, is explained by the denser population of that section, and the greater natural facilities for water supply, which cheapen the cost of water-works and make them possible for even the small towns.

The irrigation, and land and water companies are doing much to open up vast sections of the west which would otherwise be not only unfruitful, but also uninhabitable. These, and the water and gas, or water and electric light companies, are well in keeping with other vast enterprises of our country. That there is a chance in the United States for both small and great is shown by the range of capital held by the companies under consideration, it running from $3,500 to $800,000, while some of the land and water, or irrigation companies, have a capital stock of a few millions. This means water supply for large cities, for small villages, and for the men, flocks and herds scattered over the western plains.

Add to the work which will be done by the water supply companies this year, the new works established and owned by cities and villages, and we will have an unprecedented number of new water-works for one year. The activity is certainly a healthy one, and likely to continue until every city and village in the United States, with over a thousand inhabitants, has its water supply for domestic use, and protection from fire.

## CORRESPONDENCE.

### The Accident at South Heading Shaft No. 17.

NEW YORK, Nov. 27, 1887

EDITOR ENGINEERING NEWS:

The description of the ground and accident at South Heading Shaft 17, in your issue of Nov. 19, is fairly correct but the crown bars were not as large as represented. The center bar was 16 in. across the butt, but the next on the west was only 9 in. and that on the east 10 in., all the others were much smaller. It is not certain that the *two* sides and the face caved in. The east side did not cave in, as the upper side bars are still in position, neither did much, if any, of the face cave in, as the old top drift just ahead of the cave is still intact. The roof and the west side certainly did cave as described. The heading that did not cave was 55 ft. beyond the cave.

It is curious that the work is to be carried forward as it was before the accident, if your correspondent is correct, that is, crown and side bars, and the only difference is to be in the length of the sections excavated. As carried out before, the system of timbering was incomplete, inasmuch as only half of the system was applied. The crown bars are really only preliminary timbering, and should be followed by regular block or segmental timber arches, to hold the crown bars and their lagging. The objection to the shortening of the sections is that it prevents the placing of a proper grillage under the masonry. If the work is properly timbered it will hold the ground till the timber decays and enables the workmen to excavate *all* of it, before the masonry is put in.

The test of the latter amounts to just this: The bars extended from 2 to 3 ft. over the masonry, and when they fell, they pried down the extreme end of the arch and no more. There is no sign that the arch received any blow or extra pressure, except this of the bars as they turned downward at the extreme end of the center of the arch. The key, the only part, of the arch affected, is damaged only two bricks back. K.

### Unsymmetrical Sections.

EDITOR ENGINEERING NEWS:

In your issue of Nov. 12, Prof. J. B. JOHNSON takes exception to my use of the word "equilibrium" as applied to the *moments*, instead of the *forces* acting on the cross-section, and thinks that if we equate the moments the forces will not be in equilibrium and motion will ensue. In this he is in error. Equilibrium does not depend upon the amount of the opposing forces, but on their *efficiency*, which is their moment. The power upon the long arm of a lever does not equal the weight upon the short arm, but the moment of the one does equal the moment of the other.

The resistance to flexure, whether of beam or post, depends on the moment of inertia of the section. The logical inference is, that the neutral axis is, and must be that line which equates the moments of inertia upon either side of it, and not a line which equates something else. The error of the text-books consists in the assumption that the neutral axis equates the forces and not their moments.

In the same issue Mr. C. H. LINDENBERGER naively refers me for enlightenment to Prof WOOD'S discussion of the subject in his "Treatise on the Resistance of Materials," overlooking the fact that it was these very utterances of our text-books, Prof. WOOD'S among the rest, that I was calling in question. Now that this book has been mentioned, it will serve to point the error of all.

Prof. WOOD opens the subject on p. 88 of the book referred to, as follows:

"We know from statics that the algebraic sum of all the forces on each of the rectangular axis must be zero for equilibrium; hence if the deflection forces are normal to the axis of the beam, *the sum of the resistances to compression must equal those for tension.*"

So far very good. But the *resistances* are not *on* the axis, but at varying distances from it, and a unit of area at 6 ins. from the axis affords a more effective resistance than a unit of area at a distance of 2 ins

The "sum of the resistances to compression" is not the sum of the resisting *forces*, but is the sum of their *moments*; and this in turn is the *moment of inertia* on the compression side of the axis. So also the "sum of the resistances to tension," is the moment of inertia on the tension side of the axis. Hence the neutral axis must be *the line which equates these moments of inertia.*

That this line, for unsymmetrical sections, will not pass through the center of gravity has not been disputed, and needs no further discussion.

The writer of the Pencoyd book found that no other line would harmonize with experiments on beams; and I pointed out that the Watertown experiments, while too few in number to be considered proof, afford confirmatory evidence. Theory and experiment, therefore, go hand in hand, and where they lead the text-books must follow, however weighty the name upon the title page.

I thank Prof. JOHNSON for calling my attention to the foot note in Prof. DUBOIS' book of which I was not aware. I am glad to find that my position has been anticipated by so eminent a writer. It does not, however, "indicate a state of erroneous reasoning, where we should least expect it;" but it does indicate both willingness and ability to look beyond the dictum of "authority" and see the truth as it is.

THOS. H. JOHNSON.

[Mr. JOHNSON'S position appears to us undeniably correct, and we are surprised that there should be any dispute about the matter. —ED. ENG. NEWS.]

### A "Truly National" Engineering Society.

COLUMBIA, S. C., Nov. 23, 1887.

EDITOR ENGINEERING NEWS:

The necessity of a truly National Society of Civil Engineers, the influence of which shall extend into all sections of the country, is plainly felt by the younger and more progressive engineers of the South, and they would be glad to connect themselves with such an institution if an opportunity were offered them. But they are debarred the privilege of membership in the only Society of its kind in America which claims to be National, by the constitutional provision that all applications for admission, into any grade, must be endorsed by one or more members *who are personally acquainted with the candidate.* As very few young Southern engineers have the advantage of a personal acquaintance with members of the American Society of Civil Engineers, it is, of course, useless for them to apply for admission. If this rather absurd qualification, which sounds more like a college fraternity than a great National Scientific Society, could be substituted in the Student grade by a provision that all candidates must be recommended, both as to character and ability, by men of known reputation, the Society would receive in its lower grade a large number of competent young engineers from the South who would, in time, become useful and influential members. This would benefit the Society and the engineers admitted alike, and, at the same time, make the Society in truth, what it is now only in name, the *American* Society of Civil Engineers. If it persists in its present exclusive policy, which seems to be rather of personal favor than of merit, it should abandon that name and assume a merely local one, and let us have a truly National Society of Civil Engineers, in which every section of the country shall be represented, and in which professional skill, and not friendship, shall be the first qualification for membership. Such a Society will do more for the advancement of science and the protection of the profession from the degrading practises which seem to be the tendency of the day, than any Society in America at present. W.

[Our correspondent is "away off" in several respects. The American Society of Civil Engineers does not exist *merely* for scientific purposes nor for the dissemination of knowledge. Those are very important and indispensable features of it, but a primary purpose, as in the Institution of Civil Engineers and all other large national societies, is to establish and maintain a high professional standard, by

making membership in any grade an assurance that the candidate when admitted was a man of good moral and professional character, so far as was known or could be ascertained, and membership in the highest grade an assurance that he has likewise won a certain considerable standing as an engineer. To secure these important ends it is indispensable that a candidate for the higher grades at least should be known and vouched for by at least five members, as a basis for the direct investigation which is nearly always made. It is recognized that this bears hard on certain foreign residents, and a proposition is up for action at the coming Annual Meeting to relax this condition somewhat in their favor, but it is not recognized that it bears so hard on any resident of the United States or Canada that it should be relaxed. An engineer of any long experience must almost inevitably become acquainted with five members. A younger man can always obtain such acquaintance if he chooses. For example, our correspondent chances to be located where there are fewer members than at almost any point east of the Rocky Mountains, yet within a radius of 150 miles of him there are not less than twenty members. It would cost him little to get letters to five of these and make their personal acquaintance, and it would probably pay him to do so otherwise. If he will not take this trouble, how can he expect a Society which has always considered quality before quantity—and long may it continue to do so—to take him on trust?

For the proposed new grade of Students, who must of necessity be young men, only one proposer will be required, so that our correspondent's objection will be met as respects that grade, which will doubtless be open to him after March 7 next.

As for our correspondent's charge that the Society is "now only in name the *American* Society, and its present exclusive policy seems to be rather of personal favor than of merit," we must confess that such allegations, utterly without the shadow of foundation, make us rather tired, but we notice them in the belief that it is doing missionary work to promote in every way the *sound* growth of what is already a great National Society, by disabusing critics of errors. The membership is marvelously well distributed over the whole continent in proportion to engineering activity, New York City having rather less than more than its fair proportion, and the investigations for membership lean decidedly in favor of localities where the membership is thin, if there can be said to be any leaning at all. The management of the Society is open to just criticism in some respects, but in none less so than in what our correspondent alleges. It will, we hope, prove one of the great advantages of the new Student grade that it will enable young men to easily and cheaply acquire a provisional connection with the Society, and thus prevent the growth of unfounded prejudices due to ignorance until they become set with age. It is hard to teach an old dog new tricks. Of the young there is more hope.—ED. ENG. NEWS.]

## Trench Blasting.

NEW YORK, Nov. 20, 1887.

EDITOR ENGINEERING NEWS:

The writer would say to "K." who wrote on the above subject in ENGINEERING NEWS p. 370, Nov. 19th, that he has used the fascine cover he speaks of with great success. Our plan is to make large bundles of white birch, or other tough and convenient brush, the bundles being made up of small trees, say 1 in. to 1½ in. in diameter at the butt, and the natural length, which will be perhaps 15 ft. These are bound together with small chains into bundles about 1 ft. in diameter.

We load our holes with dynamite (50% usually) and then cover with these bundles of brush, and then with heavy logs, or if you have not the logs handy then throw on some large heavy stones; in fact anything to hold the brush down.

We have fired heavy charges in thick village streets with perfect safety when covered in this manner.

The brush keeps in all small stones, and a small stone will often do a great deal of damage, the brush also makes a cushion, and you do not need to put on so much heavy covering.

We have done a large amount of trench blasting, and have never been called upon for $10 in damages. It is all nonsense to smash up things as many contractors do. A little common sense and care, together with a small extra cost will almost always make all safe.

One precaution we always order to be taken when large windows are near, and that is to open the doors to stores and houses; even with this care, we have broken some glass by concussion, which shows we do not load light. Yours truly,

T. WILLIAM HARRIS & Co.
Contracting Engineers.

## Amateur Engineering.

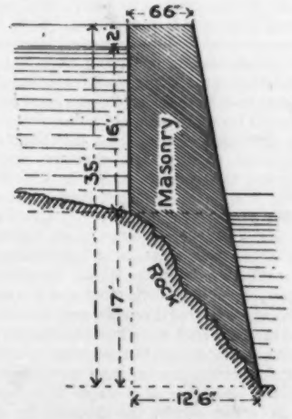
FAYETTEVILLE, Ark., Nov. 15, 1887.

EDITOR ENGINEERING NEWS:

I send herewith a sketch of the wall which broke in Little Rock, and referred to in your issue of Nov. 12. I wish to emphasize the following facts which need no comment, viz.:

1. No engineering skill was called in in either the design or construction of the wall.

2. There is an entire absence of bond in the wall, and in many cases the grouting filled spaces ½ cu. ft. in volume.




3. The foundation was on a ledge which had been so disturbed by blasting for the lower reservoir, that in places large masses of solid rock went over with the wall.

4. There are no drawings or sketches illustrating the design.

5. The wall fell *en masse*, the top falling in and the bottom going out. Yours truly,

J. M. WHITHAM.

## New York and other Municipal Buildings

EDITOR ENGINEERING NEWS:

In reference to the proposed new buildings in the City Hall Park, and the published call upon architects for designs for the same, I beg leave to offer a few remarks.

The report of the Sub-Committee of the Sinking Fund Commissioner, after deciding that two wings will be necessary, the one facing on Broadway for some 200 ft., and the other on Park Row for some 190 ft. front., uniting the present City Hall and Court House, with an "interior closed court within" the quadrangle, goes on to say:

With proper skill and taste in designing these wings, * * * the City will possess a very spacious public building sufficient for all municipal purposes * * * and *worthy in every respect of the wealth and enterprise of the metropolis.*" "The style of architecture to be that of the present City Hall."

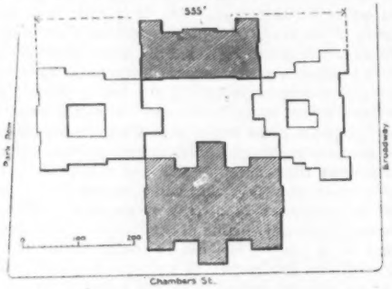
As a correct taste in architecture was not one of the qualifications precedent to the election of the members of the Sinking Fund Commission, who are to be the judges of the designs submitted by architects for the buildings referred to, I shall not be considered as in any way reflecting upon the undoubted qualifications of these gentlemen for the high offices to which they were severally elected by the people, if I call in question their fitness for the self elected duty now imposed upon them. Taste in art is a heaven-born gift, improvable it is true by cultivation, but when originally wanting, no amount of education in general, or even a technical knowledge of much that has been done, can supply it. Still less can the mere experience acquired in the engrossing pursuits of a successful mercantile life, be considered as conferring it, and yet strange to say, many persons of respectable acquirements are possessed with the idea that a knowledge of the alphabet and the multiplication table, and familiarity with the use of a two-foot rule, constitute all the essentials to the exhibition of a taste in art, particularly architectural art. It is true that the report of the committee goes no further than to imply that the design selected by these gentlemen, when constructed, will exhibit something, "worthy in every respect of the *wealth* and *enterprise* of the metropolis." This I doubt not, but at the present day surely the great city of New York, should, when she constructs her public buildings, exhibit something more than mere "wealth and enterprise." Is it too much to expect that some regard should be had to excellence in an art which, of all others, tends to indicate the state of civilization and refinement of a people, the art of architecture? Our "wealth and enterprise" as a city, is unquestioned, but we are yet wanting in the evidence of any claims to fostering a correct taste in architecture.

The Committee have shown in the present case some inkling of artistic feeling, by stipulating that the new buildings shall "conform in style to the present City Hall." This is good, so far as it goes, as it will at least prevent the perpetuation, under city authority, of such architectural vagaries as may be seen within a stone's throw of the City Park, the sole merit of which lies in their not being entirely fire-proof. But we may ask: In what does similarity of style in architecture consist? Does it lie simply in the repetition of certain details; or, is there a something else essential to style? The City Hall is of but two stories, with a center attic. To construct a *six* storied building which shall "conform to its style" would be an impossibility unless the question of what constitutes a style should be more fully understood than it appears to be at present. The City Hall may be considered as in the Venetian style, or a branch of the Italian Renaissance. So is the Court House, and yet the two are totally at variance in the mode of applying the architectural orders. In one, the orders with arcades are confined each to a single story in height, in the other, the order without arcades is carried to the full height of the building, irrespective of the stories; but neither of these buildings could be extended to a height of six stories, and harmonize with either existing structures unless by abandoning the adherence to existing details, and completing the remaining height in the *spirit* of the respective sub-styles. This can be done in the case of the City Hall without much difficulty; but not so in that of the Court House, for beyond the addition of a slight attic of a single story, there is no precedent for it whatever, and aside from this, it would be an utter barbarism to pile four stories upon such a building as the Court House, and imagine that any consistency in style could be preserved. Hence there is a serious objection to uniting the Court House with the proposed wings. The style of the City Hall however, is more flexible, and it may be preserved notwithstanding the addition of several stories, without repeating a single feature of the existing structure, by simply observing the principle of the style as exhibited in some high buildings of the same architectural age.

Here it may be well to add that a properly designed architectural feature, though simple in itself, may become highly effective by its repetition in a horizontal line, while this same feature, if repeated vertically, will lose all value, and prove utterly effectiveless, as is illustrated in many localities in the city, notably STEWART'S store, at the corner of

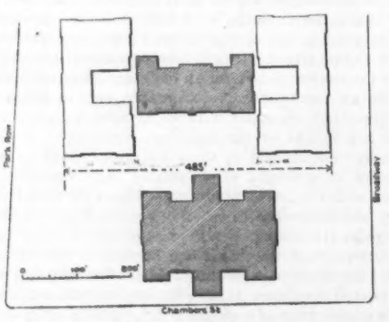
Broadway and Tenth street, wherein, the detail of all the stories being exactly alike (of cast-iron from the same patterns), there is an absence of any controlling feature upon which the eye may rest with satisfaction, a. d to which the remainder of the com position is subordinate.

Again, as the printed "requirements" to which the competitive designs are restricted, specify the height of the several stories in the "wings," which differ from those of both the City Hall and the Court House, and yet require all four of the buildings to be united to constitute, in effect, a single building, the string courses of the several buildings cannot conform one with the other, being at different levels, and will necessarily break upon the several buildings without any conformity, save by accident. Now, if any *oneness* of effect be aimed at, which is essential in any group of buildings having pretensions to architectural composition as a unit, some expedient must be resorted to whereby these irregularities may be reconciled.




**Design of Commissioners.**

The obvious method of doing this, is not to unite the several buildings in reality, which may be effected without any violence to the design as a consistant architectural composition, by bringing the "wings" forward (their ground plan being simplified by a change of outline) so that the shorter axis of each wing, shall be on a prolongation of the longer axis of the City Hall, and detaching the wings a short distance from the flanks of the City Hall, thus preserving the several string courses of the buildings intact. The small distance between the buildings will not be apparent in the sky line, owing to the peculiarity of the outline of the wings, and if closed at the basement by screen and gateway, it will group them as parts of a whole. The Court House, thus thrown into the rear, forms no part of the composition, either in appearance or reality. A




**Design of Philo-Artis.**

clear passage way with shrubbery, extending between the City Hall and Court House from Park Row to Broadway, will allow free passage, as at present, from street to street, devoid of the objectionable archways at the corners of the wings (as proposed by the Committee) which, while affording ingress and egress *on paper*, virtually makes the interior quadrangle a closed court, and diminishes very materially the circulation of the air, and convenience of access.

As a means towards insuring uniformity in style, two stories and a mansard can be added to the City Hall, making it five stories in all, which the dimensions of the present walls will permit without difficulty, and the additional floor space will be an improvement.

By this method, and with a greater floor space than is afforded by the plan of the committee, the extreme width of the combined building from east to west, will give a less frontage, and occupy less of the restricted width of the City Park by over 60 ft.

In securing the desired floor space, in the plans of the Committee, and to unite all four of the buildings, the ground plan of the wings is made to increase in width from about 45 and 50 ft. within the Court, to 190 and 215 ft. on the Broadway and Park Row fronts, by breaking up and stepping back flanks in *échelon*. This, it might be claimed, would be conducive to picturesqueness of effect through the broken sky-line, but so far from this being a proper consideration, it would prove destructive of a higher quality in a grand city building, viz,—a proper repose and dignity of outline, qualities far more desirable in a public building of such pretensions, and in so commanding a situation as this.

I think, Mr. Editor, that I have shown ample reasons why the Sinking Fund Commissioners, while they may with propriety indicate, as they have done, their preference for a certain arrangement of the new buildings, for the guidance of architects, should also allow some latitude to such as have special views to offer as to the arrangements of the wings, to which the commissioner might give such consideration as the importance of the subject might warrant. What I mean is, that plans of obvious merit should not be thrown out without due consideration, simply because they did not comply with the cast iron "requirements" of the printed programme of the committee. They may have given much study to the subject, but it is possible that something worthy of consideration may have been left which their gleanings had overlooked, and this leads me to a final remark:

The commissioners, to guard against the possible artistic clap trap of clouds, fictitious shadows, foliage, figures, bright colors, etc., have restricted the drawings to simple outline in black ink, without shadow even in the window openings. Now so far as color is concerned, and landscape accessories, this restriction is admissible, providing they feel their inability to otherwise sift the chaff from the wheat; but I suggest, that in their indifferent knowledge of such matters it would be some aid to the commissioners to have the distinction at least between flat and round apparent to the eye, without drawings being necessary to determine which is which. For instance, the bare outline without shade, will represent equally a round column in front of a deep recess or portico, and a flat pilaster of the same width but only a few inches deep, and so will *not* represent by comparison its character or purpose. Similiarly in the elevation, say of the south front and wings (one of the drawings required) the east and west boundary lines of the City Hall, are a hundred feet in front of the flanks of the wings, but no relief is afforded in the outline drawing greater than would be shown in the case of a moulding of a couple of inches projection! In other words, the *laymen*, by which term I mean the judges in this case, *are given a false idea of what they are to pass judgment upon*, an idea which nothing in their daily experience furnishes a scale by which to rectify it. I would suggest that the drawings be allowed to be executed in black and white (india ink wash). Some shade and shadow is essential to truth of delineation, which is enhanced and not weakened by its moderate use.

PHILO-ARTIS.

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IN a lecture given at Dundee, Mr. BAKER, one of the Forth Bridge engineers, tells a fine story of modern heroism. Six men were one day working at the bridge, standing on a plank 140 ft. above the sea level. One of the hooks supporting the plank gave way. With great presence of mind three of the men sprang at the steel-work of the bridge, and held on; a fourth dived, was rescued, and, it may be added incidentally, almost immediately resumed work. Of the three hanging to the steel-work by the arms, two were in particular danger, yet when the rescue party reached the first of them, he said: "I can hold on; go to the other man; he is dazed."

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THE Dickson Manufacturing Co., of Scranton, Pa., has just completed one of the largest boilers ever constructed in America, for the Calumet & Hecla copper mines of Michigan. It is 35 ft. 4 in. in length, 10 ft. 6 ins. wide, and 11 ft. 6 ins. high. It would take one man 2,200 days to build it. It weighs 45 tons and is of 1,000 H. P. The boiler is made of steel from the Otis Steel Works at Cleveland. One sheet used weighed two tons. The "crown sheet" is 1⅝ ins. in thickness, that near the valve is ¾ in. and all other parts 9-16 in. There are 198 three-inch tubes in the boiler, a double fire box connecting with the flues, and 30 "hand holes" for the purpose of cleaning the boiler.—*Exchange.*

## PERSONAL.

Col. WILLIAM W. HAMERSLEY died recently in Allentown, Pa. He was prominently connected with the construction of the North Pennsylvania and other early Pennsylvania railroads. During the Civil War he commanded the 128th Pennsylvania Regiment, but was so badly wounded at Antietam that he retired from the service and was afterwards appointed Provost Marshal of the Eastern District of Pennsylvania.

F. W. FRATT has been appointed Chief Engineer of the Wisconsin Central associated lines.

GEORGE C. MORGAN, C. E., of Chicago, has been engaged to investigate the proposed water supply and prepare plans for a system of water-works for Centralia, Ill.

W. R. COATS, C. E., of Kalamazoo, Mich., has been engaged to investigate and report on a system of water supply for Hillsboro, Ill., and to prepare plans and estimates for water-works.

DAVID H. WINSTON, Assistant Superintendent of the Kansas City, St. Joseph & Council Bluffs R. R. and the Hannibal & St. Joseph R. R., with headquarters at Kansas City, Mo., has resigned his position. He will be succeeded by E. G. FIEH, of Atchison, Kan.

J. R. HARDY, of the Kansas City, Fort Scott & Gulf R. R., at Springfield, Mo., has been promoted to the position of Superintendent. Mr. HARDY was until a few years ago Superintendent of the Kansas City, St. Joseph & Council Bluffs R. R.

The firm of BAYLOR & BAYLOR, Civil Engineers and Surveyors, Atlanta, Ga., has been dissolved by mutual consent. H. B. BAYLOR is at Atlanta, Ga., and T. G. BAYLOR is at present at Charlestown, W. Va.

WALTER G. BERG, formerly Assistant Engineer of the Lehigh Valley R. R. Co., has been appointed Principal Assistant Engineer and will take entire charge of the Eastern terminal work of the Lehigh Valley R. R.

ALVEE M. TUCKER has resigned his position as Superintendent of the Susquehanna division of the New York, Lake Erie & Western Railroad.

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## Sinking a Shaft Through Loose Material.*

### Method Employed Successfully at the "Tilly Foster" Mine.

Fig. 1. Plate 1, gives the general outline of a section taken through the center line of the shaft. It will be seen that one of the chief dangers to the sinking of the shaft lay in its nearness to the retaining wall shown on the section, which held in place the mass of broken rock, dirt and debris, through which it was necessary to sink, and any movement of the mass must of necessity carry out the wall. Accordingly a pit 8×10 ft. at the bottom was dug in the top of the heap as deep as could be without the sides caving in, and in the bottom of this pit a shaft set, made of round oak sticks 10 in. at the butt, was laid at an angle of about 80° with the dip of the foot wall. Stulls were then cut from this set 4 ft. long, on top of it was placed a second set, and so on up for another set, until the level of the plat was reached. The timbering then consisted of a frame the size of the shaft, but unplanked. Two-inch oak plank, not over 9 in. wide, were then driven under the caps of the upper sets and over the caps of the lower as far as they could be driven, after which the dirt was filled in around the top of the shaft, a levelling set put on, and the top planked over and rigged with a windlass. This stage of the work is shown in Plate 1, Fig. 2.

The lower row of planks were then driven, one at a time all round, and as fast as they were down, the dirt and rock inside the shaft was hoisted, until about 6 ft. had been excavated, when another set was placed and a new row of planking started, the set being supported on short blocks, or often resting on the dirt at the cap end. When about 35 ft. had

*By A. McC. PARKER, E. M., from the School of Mines Quarterly October, 1887.

been sunk, the top of the retaining wall gave way and slid out into the pit, carrying about 15 ft. of the shaft with it, but leaving the bottom intact. This, fortunately occurred in winter, just after a

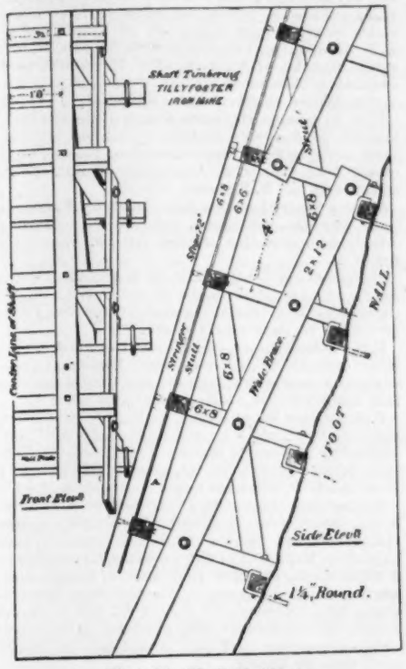


Plate II.—Shaft-Sinking.

thaw, when the whole mass was thoroughly wet. The shaft was then allowed to stand until a cold snap should come, and in the meantime a new wall was built outside the old one, strong enough to stand, and by the time this was up the whole mass of loose material was frozen solid. The top of the shaft was then opened, a new collar and four sets put on, first having put on a levelling set that extended 2 ft. beyond the original set, to rest on the dirt, the whole top double planked with 2-in. oak plank, the pit filled in and tamped, and all was ready to try again.

When the planks were driven they bore against the dirt on the outside of the cap of a lower set, tending to crowd it towards the wall, and on the inside of an upper set. This last pull was resisted by the dirt and the thrust of the planking on the other side of the cap, and consequently the harder the plank were driven the stronger the shaft became.

The sets were partly supported by the friction of the planking against them and partly by setting them not normal to the dip of the shaft, but an angle considerably above the normal, so that as they tended to slip down at the cap end they became longer in a direction normal to the dip and consequently exerted a thrust against the overlying dirt, which was practically solid because of the frost. No trouble was encountered on this score, however, and gradually, without further mishap the excavation passed through boulders, fine stuff, large masses, etc., until it reached the solid bottom of the pit, the shaft having previously been raised in this solid from the roof of the 300 ft. level, leaving a cap of 4 ft. over it. When the solid was reached, coming down, this cap was broken out, and after trimming down and enlarging the opening all was ready to secure the temporary shaft. A beginning was made by levelling off the floor of the pit around the opening and putting on a heavy oak collar, framed as were the other sets. Stulls were then cut from the ends of the cap to the end of the cap of the set above, and one on each side about the middle of the legs. These were wedged solid. After carrying up about four sets we began at the bottom set and wedged it all around on the under side until no more could be driven. The planking last put in was then driven as far as it would go, when the ends of the plank were cut off just under the cap against which they bore on the inside, and without any trouble, owing to the spring in the plank, their ends could be forced outside the line of the caps. This alternate stulling and cutting of the planking was carried up to the top and when completed the shaft was solid and double planked with 2-in. oak plank. But little dirt came into the shaft through the joints in the planking, and the progress made was quite satisfactory, about a foot a day being sunk with a single shift of five men.

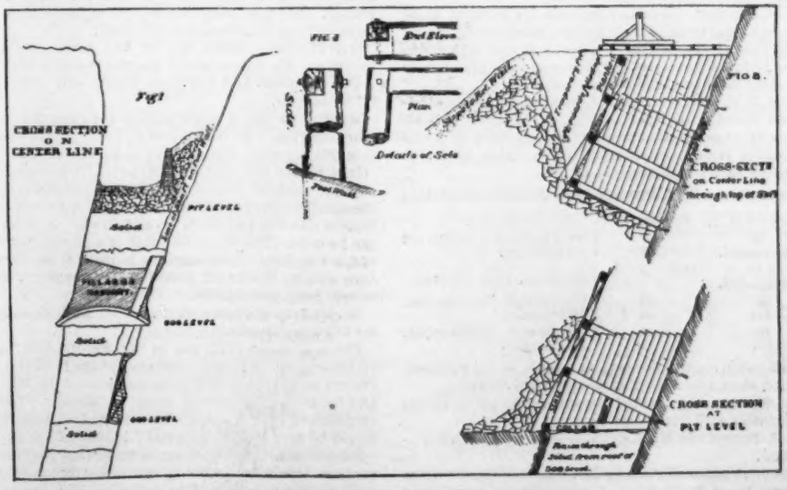


Plate I.—Figs. 1, 2 and 3, Shaft Sinking.

The details of the sets are shown in Plate 1, Fig. 3. The caps and legs were flatted on two sides only, the cap was then notched half through at each end and a shoulder 1 in. wide was squared off on the end of each leg. The corresponding notch on the legs was cut so that the cap and legs went together and the 1-in. shoulder on the leg bore its whole length on the cap. The legs were then cut to fit the foot wall and the right length to bring the cap out to line, after which the cap was bolted on by a ¾-in. bolt, a 1¼-in. iron pin let in to the foot wall, supporting the foot of the leg on the wall.

As this shaft was to be part of the shaft built in pillar 2, south (see article on Masonry Supports, etc., of the Tilly Foster Mine, *School of Mines Quarterly*, May, 1885), it may be well to describe the system of timbering used in going from the 400 level to the 300 level in room 2, south, climbing up the footwall to connect with the piece built in the masonry. A track was to be carried up on a 3½ ft. gauge. The caps of the sets were made 6 ft. 4 in. long, and the timber used was 6×8-in. spruce. Two inches to the foot was the flare adopted for the legs, and they were tenoned into the caps with heavy tenons the full width of the legs. The legs were fastened to the foot wall by means of ¾-in. bolts running through their ends, which butted on and were cut to fit the wall, and through 6×6 in. or 6×8 in. sticks that lay on the foot wall as nearly as possible, held to the wall by 1¼-in. round iron cramps, put into 16-in. drill holes and well wedged. After the first set at the 400 level was in place, normal to the dip of the shaft, stulls 3 ft. 6 in. long (A. Plate 2) were cut and put on the cap over the tenons, and spiked. Temporary stulls were similarly placed near the sill ends of the legs and the measure taken for the second pair of legs. They were then cut off, cut to fit the foot wall, the cap put on and the legs bolted to the piece on the foot wall, and so on up.

The next step was putting on the stringers, which were placed 3 ft. 4 in. between centers, laid on the flat and cut 20 ft. long. They were notched down to 5 in. where they went on the caps and locked on each cap. Five-eighth inch bolts were run through at each intersection, with heavy washers, and the whole set up snug. After this much was accomplished, long 6×6 in. struts were cut from the cap of each third set to the stick cramped to the foot wall on the inside of the corresponding set below. On the outside of the sets 2×12 in. spruce plank 18 ft. long were used as wale braces, running from the sill of one set gradually to the cap of the fourth set below, and bolted at each intersection with the legs. The result is a shaft, very stiff laterally and vertically, while the time required to erect it was very short.

Any one piece can be readily taken out and replaced, and repairs made at any time.

## Items of Foreign News.

Opening bids for the harbor works at Horia, Fayal, Azores, is fixed for Dec. 5. The estimated cost is $1,200,000. A preliminary deposit of $61,000 is required.

Messrs. Humes & Co., representing J. Meigs & Co., offer to construct a line from Colonia Galvez, in Santa Fé, to Buenos Ayres.

They are speaking in Buenos Ayres of a Metropolitan road that will cost $20,000,000.

Senor MATHIAS SANCHEZ, an engineer, is to visit the United States and Europe with the view of purchasing the machinery for working the coal mines of Paganzo, Arg. Rep.

The most northern railroad yet built, that from Luba to Opsten, in Sweden, was opened Oct. 7, the line passing over the Arctic polar circle.

The Danish Rigsdag will soon consider plans for the building of a bridge of 2,800 metres (9,184 ft.) over the arm of the sea that separates the islands of Seeland and Falster. There will be 40 piers. The cost is estimated at $1,870,000.

A letter from the Belgian Consul at Rostoff, on the Don, states that a committee has been formed to study the advantages resulting from a canal joining the Volga and the Don. Peter the Great had some preliminary cutting done between Kalatch and Tsaritsin, the distance between them is about 70 kilos. (43.4 miles.) It is this line that has been chosen by the commitee. The committee has raised 50,000 roubles and engaged French engineers. The cost is estimated at $14,000,000.

Lectures will be delivered in Berlin, Breslau, Cologne, and Eberfeld on various railway matters during the winter.

The Greek Government proposes to enlarge the Strait separating the island of Eubacus from the Continent. The company of the Lauriuin Mines has undertaken the works.

Great works are to be done in Buenos Ayres. The new mayor wants to borrow $20,000,000 in the first place—of course, as a municipal debt—but he adds the word "interior." Surveyors will have a show, for new streets have to be laid out and old lines rectified.

A new company in La Plata has the Argentine title of "Constructora Santafecina," but only wants to build up tramways—and other things.

## SOCIETY PROCEEDINGS.

**American Society of Mechanical Engineers'. Meeting at Philadelphia.**—The opening session was called to order at the Continental Hotel at 8 P. M., Nov. 29 about 130 members being present.

The president of the Society, Mr. GEO. H. BABCOCK, made the opening address upon "The Engineer, his Commission and his Achievements." He stated that: The membership now numbered over 800. In the field

of engineering we are in the midst of a wonderful progress. The civil and mechanical engineer have both helped in this, and are mutually dependent on each other. The civil engineer may lay out railroads and waterways, but he cannot equip them without the aid of the mechanical engineer. The commission under which he works dates back to the earliest history, to the time when the first man was commanded to subdue the earth. Of 50 metals known, only 18 have yet been used, and not more than a dozen to any considerable extent. Of 10,000 steamers now in service 9,000 are built of iron or steel, comprising 96 per cent. of the total existing tonnage. Civilization, if not existence, is dependent upon coal. Of petroleum 1,000,000,000 galls. are annually produced in the United States, and in Russia 100,000,000 galls. more. Among achievements, the Mt. Cenis tunnel was completed, only to be surpassed by the St. Gothard tunnel, with its remarkable spiral approaches, its 9 miles of length exceeding the preceding undertaking. The engineer has covered the earth with bands and a network of iron. Of railroads there are 350,000 miles, nearly one-half being in the United States.

The engineer has harnessed the force of gravitation and the power of falling water. Another force is that of momentum or inertia. By means of it windmills are made useful, and it is the principle in all hammers. By it the heaviest armor can be pierced or in the centrifugal machine we can employ it to dry clothes.

"Heat has had a wonderful developement. Only the century before the last brought out the heat engine, which does twice the work capable of being done by the entire population of the world.

"$100,000,000 are spent annually in the United States for fire insurance. Automatic sprinklers have diminished fires 95½ per cent. where they are used. Lightning had been known as a terror or played with as a toy, until Franklin showed the identity of the two manifestations. As electricity, it has been employed to ring call bells, as a motor for street cars, for welding and for smelting ores. Its chief use so far has been for carrying messages. There are 1,700,000 miles of telegraph wire stretched on poles throughout the world, besides 11 cables between Continents. Electricity will reproduce our voices hundreds of miles away, and will draw and reproduce even our handwriting. In all directions discovery has followed discovery in an increasing geometric ratio.

"As to the future, it may be said that we may be able to obtain our heat and power direct from its source, the sun, which expends upon us each minute the equivalent of the heat of 1,000 000,000 tons of coal. The generation of electricity directly from coal is now being worked upon by a member of the Society, Mr. EDISON, in his thermo-electric generator.

"We may utilize our waste water power, of which there is 200,000,000 H. P. in the world, in the running of dynamos for producing the electric current. Flying is simply a question of obtaining sufficient power within a given weight. We have already diminished the necessary weight of our motors 35 per cent.

"The meaning of engineering is to make man the master, where before he was the victim of the forces surrounding him."

Prof. JOHN E. SWEET, next read a paper (I) upon "A New Principle in Steam Piston Packing." Heretofore the principle of packing, as with hemp, has been to press it outward to the surface of the cylinder. This packing is simply an eccentric ring of metal, cut, and hooked together by a hook clamp so that it forms a ring. It can contract but cannot expand in size. Prof. WEBB said after the packing is in place, and the cylinder becomes hot, it is equivalent simply to a good fitting solid piston. Prof. SWEET said that as to tightness a man put 95 lbs. steam pressure in one end of the cylinder and his head in the other, without inconvenience. This packing tends to make the cylinder surface wear parallel. Mr. STRONG said one form of packing was a loose ring which carried the weight of the piston-head upon it in the cylinder.

Topics 50 and 51, were then taken up viz: What is the best form of pump to use with driven wells, where lift is 10 to 20 ft. and air is likely to get into the suction? Should the pump be single or duplex, and with piston or plunger; and have you used driven wells successfully; of what sizes and depths, and singly or in groups? The discussion seemed to be in favor of the single acting pump for reliability of action, and ease of draught.

At the second session, Tuesday A. M. Nov. 29, the Secretary, Prof. F. R. HUTTON, read the annual report of the Council and of the Finance Committee. Prof. HENRY R. TOWNE made the report of the Committee on Library, and of the Committee on Tests and Test Specimens. HORACE SEE, of Philadelphia, was elected President for the ensuing year: HENRY G. MORRIS, W. S. BAKER, C. J. H. WOODBURY, Vice Presidents; WM. H. WILEY, Treasurer; STEPHEN BALDWIN, F. GRINNELL, and MORRIS SELLERS, Managers.

The next papers read were two by HENRY P. SNELL, of Philadelphia, on (II) "Experiments and Experience with Blowers," and (III) "Economical Method of Heating and Ventilating an Office and Warehouse Building." Of the power used in running fans, about 65 per cent. can usually be recovered. Where excessive power is required, the trouble is more apt to lie in long and crooked pipes with bends, and their becoming clogged with dirt than in the fan itself. The method of heating described was that of forcing air into the room by an exhaust fan. Exhaust and live steam is admitted in inlet pipe to fan for the heating.

Mr. WOODBURY.—The latest methods of heating used by the Sturtevant Blower Co. and Exeter Machine Co., consists in supplying the air by blowers, the air being heated by steam pipes in air reservoirs. The second method is heating by overhead pipes. The third method was to place the pipes around the walks beneath the windows. A method which has proved satisfactory is that of suspending four pipes by yokes suspended by rods 4 ft. from the ceiling. Replies from inquiries of 42 mills showed 40 to be favorable to this method.

Mr. ASHWORTH.—Blowers are found to absorb far more power than the makers represent is required. A 6 H. P. Sturtevant blower used over 15 H. P. A Boston blower of 42 in. wheel, required 18 H. P. Others, up to 50 H. P.

Prof. DENTON.—The power required in a blower, varying as the cube of the volume, is shown with substantial accuracy in the tables in Mr. SNELL'S paper. The experiments in Sturtevant's book are still the best we have. Positive blowers, like the Root, are sure to give the blast without the limitations of the fan blower.

Mr. MATTES experimented for years both with the Baker positive blower and Sturtevant fans, and finds the latter superior on account of the expense of repairs and difficulty of handling the parts in using the former.

Mr. SCHUMANN.—With a Baker blower the maximum power is used all the time, with the fan blower he considered it to be an advantage because it could be throttled down to give less power when less is needed.

Mr. FELTON said that the experience in Pennsylvania steel works was in favor of the Baker blower, as this is used almost exclusively in all Bessemer steel works. Pressure used is about 12 OZ.

Prof. R. H. THURSTON.—The best form of blade is nearly a straight one. The curved blade should be run with the convex side advancing. A straight blade gives as great efficiency as a considerably curved blade. The blade should be so formed as to cut into the current of air without shock, and the outer terminus should be so shaped as to have nearly the velocity of the air current.

Prof. DENTON.—The exact formula for form of blade is to be found in Rankine's Applied Mechanics.

Mr. SNELL.—The action of air in a blower is that due to centrifugal force, and the blower should give nearly the same blast run in either direction.

Prof. R. H. THURSTON next read a paper on the "Internal Friction of Non-Condensing Engines," giving tables of experimental results, and showing that the amount of friction is constant with varying loads. It probably varies with the speed.

DISCUSSION.—Prof. DENTON gave the following table:

| *Indicated H. P.* | *Friction H. P.* | *Style of Engine.* |
|---|---|---|
| 84 | 7 | Westinghouse, 12×11 3.0 |
| unloaded. | 10 | revolutions. |
| 23 | 5 | Buckeye, 7×14 280 revo. |
| unloaded. | 5 | |
| 347 | 44 | Compound Condensing, |
| 185 | 40 | Throttling. |
| 181 | 19 | Compound Condensing, |
| 137 | 25 | Expansion. |

This confirms the anomalous result as to constant friction shown by Prof. THURSTON'S experiments,

Mr. WEBBER has reached the same conclusion in his experiment with dynamometers.

Prof. TOWNE and Mr. KENT also took part in this discussion.

The next paper (V) was by Mr. OBERLIN SMITH upon "Power Press Problems." A great deal of percussive action takes place which does not exist in other machine tools. On account of this, every part must be so designed as to firmly hold together against the pounding. Five or six interlocking points for the clutch in a revolution are now required, also the avoidance of back-lash.

DISCUSSION.—Mr. W. LEWIS.—Positive clutches are now used by Wm. Sellers & Co., and are very satisfactory. Mr. GRANT, Mr. CRANE, Mr. COFFIN and Mr. STILES also discussed this paper.

The afternoon (29th) was spent in visiting, by invitation, many of the works in Philadelphia having an interest for the members. Among these were the Baldwin Locomotive Works, Bement, Miles & Co., and Wm. Sellers & Co.'s machine works; the Bergner & Engel Brewing Co., Henry Disston & Sons works at Tacony, where a water-gas plant was seen in operation; the Keystone Incandescent Electric Light station; the Electric Car station, the Mint, Kensington Engine Works, Water-Works, where a test of the Holly engine was in progress, etc. A tug was taken up the Delaware to Wm. Cramp & Sons ship and engine works, where the new U. S. Cruiser *Baltimore* is building besides U. S. Gunboat No. 1, and the U. S. Pneumatic Dynamite Gunboat. The leading particulars of the work on hand here are as follows: Steamer *Baltimore*, length, 335 ft.; breadth, 48½ ft.; mean draught, 19½ ft.; tons, 4,400; horizontal, triple-expansion, twin-screw engines. Four double-ended return tubular boilers, 135 lbs. steam, 9,000 ind. H. P. U. S. Gunboat No. 1, length, 230 ft.; breadth, 36 ft.; mean draught, 14 ft.; tons, 1,700. Horizontal, triple-expansion, twin-screw engines: four cylindrical locomotive boilers, 160 lbs. steam; 3,000 ind. H. P.

U. S. Pneumatic Dynamite Gun-boat; length, 276 ft.; breadth, 26½ ft.; mean draught, 8½ ft.; tons, 700; guns, three 15-in. vertical, triple-expansion, twin-screw engines; four cylindrical locomotive boilers, 160 lbs. steam; 3,500 ind. H. P.; speed, 20 knots.

Also machinery for steamboat *Connecticut*, Stonington line: diagonal, compound, side-wheel engines; six cylindrical locomotive boilers, 110 lbs. steam; 5,000 ind. H. P.

Steamboat for Central R. R. of New Jersey; length, 250 ft.; breadth, 35 ft.; mean draught, 10 ft.; vertical, triple-expansion, twin screw engine; four return tubular boilers, 160 lbs. steam; 2,500 ind. H. P.

U. S. Cruiser *Newark*; length, 310 ft.; breadth, 49 ft.; mean draught, 18½ ft.; tons, 4,083; horizontal, triple-expansion, twin-screw engines; four double-ended return tubular boilers, 160 lbs. steam; 8,500 ind. H. P.

U. S. Cruiser No. 4; length, 335 ft.; breadth, 48½ ft.; mean draught, 19½ ft.; tons, 4,400; horizontal, triple-expansion, twin-screw engines; four double-ended return tubular boilers, 160 lbs. steam; 9,500 ind. H. P. Total ind. H. P. of vessels under construction 41,000.

The members also visited the works of J. P. Morris & Co., where were inspected the hoisting engines "Houghton" and "Seneca," with other machinery being built, from Mr. E. D. LEAVITT'S designs, for the Calumet & Hecla Mining Co. The dimensions of these engines, which are triple-expansion, direct-hoisting beam engines, are: Cylinders, 18 in., 27½ in., and 48 in. diameter; 7 ft. 6 in. stroke; boiler pressure, 180 lbs.; shafts, links, connecting rods and cross-heads of crucible steel, made by KRUPP.

At the third session, Tuesday evening, Mr. JOHN J. GRANT, of Philadelphia, read a paper on "The Milling Machine as a Substitute for the Planer in Machine Construction." The use of the milling machine has developed to such an extent that it is rapidly displacing the planer in finishing all parts of machines. A continuous rotary motion is obviously better than any form of intermittent motion. 15,000 sewing machine beds have been finished by milling instead of by the planer. The chief shops are providing themselves with large milling machines for this work.

Mr. TOWNE.—Cutters are of two forms, solid and movable. Mr. GRANT would use the common cutter for plane surfaces, and a face or rotary planer for large thin surfaces.

Mr. POTTER has a large milling machine that would take castings 7 ft. wide by 16 ft. long, and considered that this machine would do the work of four planers.

Prof. SWEET has a large machine which appears like a planing machine, except that it has a milling tool. He uses cutters from 3 to 16 ins. diameter. The cross head weighs one ton and feeds up and down. A ⅞-in. drill can be used. The bed is like that of a planer, but wider and not so deep. This machine is used at the Straight Line Engine Works for finishing their engines. Slots are cut 2 ins. per minute.

Mr. DURFEE showed a sketch of an English machine for finishing cranks.

The next paper (VII) was by Mr. FRANK VAN VLECK, of Ithaca, on "Standard Section Lining." A standard system or universal sign language is used in Heraldry and for geological survey maps in Europe. The advantages of such a system for mechanical draughting, would be very useful, especially in railroad work.

DISCUSSION.—Prof. HUTTON thought that the chief advantage would be in the illustrations of machines in engineering papers and periodicals. The use of section lining is comprehensible in all languages, while lettering would be understood only in English.

Mr. GRANT thought that standards should be made, but embellishment should be as simple and easily made as possible.

Mr. TOWNE uses symbol letters indicating different metals.

Prof. WILSON thought the proposed committee should consider whether the ordinary section lining should stand for a material as well, also that broken lines should be avoided.

Mr. HALSEY thought the matter was draughtsman's nonsense, that the result would be necessarily imperfect. He believed in calling a spade a spade and writing the name of the material on the drawing.

Mr. COFFIN said nothing tires a draughtsman more than coming across a complicated system of sectioning. He favored writing the name of the material on the drawing.

Mr. TOWNE moved that a committee be appointed to consider this subject. Coloring for materials as cast-iron, wrought-iron and brass was more obvious than a

name would be. Something should be done to make our modern blue prints as plain as the old method of coloring.

Mr. LADD thought the committee's first action should be to determine whether such a thing was desirable or not.

Prof. SWEET opposed appointing the committee. Mr. KENT thought it a useless refinement.

The motion to appoint the committee was lost.

Mr. WIGHTMAN showed some of the difficulties of what was proposed, in practice.

The next paper was by PERCY A. SANGUINETTI, of Philadelphia, on "The Divergencies in Flange Diameters of Pumps, Valves, etc., of Different Makers." A table given showed the variations in flange diameters.

Mr. WEBBER gave figures showing the same divergencies.

Mr. TAYLOR said that the conditions in cylinders and pipes are so different that a proposed standard seemed to be impossible.

Mr. TOWNE showed a formula for proportioning flanges, and said the sizes would vary whether the pipe be cast-iron, wrought-iron, copper or other material, and the flange necessary would vary with the number of bolt holes.

Mr. REYNOLD favored some standard for approximate use.

Mr. KENT favored the appointment of a committee to report on such a standard.

Mr. MATTES also favored it. Mr. HAWKINS favored the committee but not the indorsement of a standard by the Society.

Mr. E. F. DAVIS found that a standard he had adopted was very advantageous.

Mr. TOWNE—The refusal of the Society to indorse any report of a Committee is similar to the position taken over ten years ago by the Society of Mining Engineers.

Voted to appoint a committee to report on an uniform standard.

The next paper (IX) was by WM. O. WEBBER, of Boston, on "Centrifugal Pumps and their Efficiencies," and gave results of experiments.

DISCUSSION.—Prof. THURSTON said that this was a similar question to that raised in the discussion on fan blowers. The appold or involute form of blade he found had given satisfaction. We may have any one of a number of forms of blades to comply with the conditions.

Prof. WOOD said that RANKINE assumes that at the maximum efficiency the fluid leaves the vane radially or in the direction of centrifugal force, and this is nearly correct. The terminals of the vane are fixed, but variations of form between the terminal are arbitrary, and any number may be used. Having determined on a form, the efficiency varies with different speeds.

Mr. BILGRAM.—The course of the water in a centrifugal pump is of the same angular velocity, but increasing in actual velocity, in an arithmetical ratio. At all points the blade should be at right angles to the course of the water.

Prof. DENTON.—In turbine water-wheel building theory did very little in perfecting the turbine. The on'y method was that of making the flow of water as smooth as possible. Our experiments are not complete enough to destroy Rankine's theory.

## Statistics of New Railroad Construction.

### SOUTHERN STATES.

*Accompanying Map No. 4 of the Progress and Prospects of Construction.*

The classification by "Existing Roads" and "New Projects and Surveys" in the following list is the same that is ordinarily used in our Railroad News, the latter including only the schemes and surveys of new and independent companies which have not yet begun grading. "Track laid" is, of course, since the beginning of the calendar year. "Construction" includes lines now building, and partially graded roads which have a fair prospect of early completion. "Survey" includes lines on which engineers are now at work, and located roads whose projectors are making some move toward construction. "Projected" lines are those not yet located, but which from all the data furnished we conclude to have some chance of construction within a reasonable time.

It need hardly be said that the "projects" we give below are but a few out of the almost numberless schemes reported to us. Concerning any of the projects we have omitted to mention, we shall be pleased to receive any farther proof of the solidity of their backing and their general feasibility which their promoters may wish to present. As for those included in the list, we especially desire further information of their progress, and also corrections and additions to the list of "Existing Roads."

The map showing the construction in the Northwestern States and the tracklaying over the whole country for the current year, are in preparation; and our correspondents are requested to favor us with data required for their compilation at their earliest convenience. We also take this opportunity to extend our thanks to the officers of the Southern roads by whose aid we have been enabled to make our map and list of the Southern States as accurate and complete as its importance deserves.

### VIRGINIA

#### EXISTING ROADS.

1. *Atlantic & Danville.*—Track laid, Portsmouth to Suffolk, 20 miles; under construction, Suffolk to Danville, 175 miles.

2. *Charleston Cincinnati & Chicago.*—Under survey, terminus 10 miles south of Richardson, Ky., to Virginia coal fields, 100 miles; projected, coal fields to Johnson City, Tenn., 60 miles.

3. *Durham & Lynchburg.*—Under construction, Lynchburg to Rustburgh, 10 miles; under survey, Rustburgh to Durham, N. C., 96 miles.

4. *Norfolk & Western.*—Under construction, Clinch valley division, Blue Fields, Va., to Big Stone Gap, 130 miles.—Chamber's Valley & New River, surveyed, Reed Island Junction to Mt. Airy, N. C. 45 miles.

5. *South Atlantic & Ohio.*—Track laid, Hilton to Clinch river, 16 miles; under contract, Clinch river to Big Stone Gap, 60 miles.

#### New Projects and Surveys.

6. *Craig Company's Railroad.*—Projected, Roanoke to New Castle, 15 miles.

7. *Danville & Seaboard.*—Projected, Danville to Henderson, N. C., 60 miles.

*Mineral.*—Projected, Strasburg Junction to Stony River, W. Va.

### NORTH CAROLINA.

#### Existing Roads.

9. *Albemarle & Pantego.*—Track laid, Mackey's Ferry to Juniper Log, 10 miles; under construction, Juniper Log to Pantego, 20 miles.

10. *Atlantic Coast Line.*—Track laid, Rocky Mountain to Spring Hope, 19 miles, Clinton to Warsaw, 14 miles; under construction, Pee Dee river to near Little Rock, 11 miles, Scotland Neck to Greenville, 40 miles; under survey, Fayetteville to near Little Rock, 47 miles.

11. *Cape Fear & Yadkin Valley.*—Track laid, Belew's Creek to Pilot Mountain, 32 miles; under construction, Pilot Mountain to Mount Airy, 14½ miles, Stokesdale to Madison, 11 miles; projected, Fayetteville to Wilmington, 80 miles.

12. *Charleston, Cincinnati & Chicago.*—Projected, Rutherford to Marion, 20 miles.

13. *Jamesville & Washington.*—Projected, Jamesville to Mackey's Ferry, 20 miles.

14. *Marietta & North Georgia.*—Track laid, State Line to Kinsey's station, 8 miles; under construction, Kinsey's Station to Murphy, 6 miles; under survey, Blue Ridge, Ga., to Hiwassee River, Tenn., 28 miles, also Murphy to Valleytown, 17 miles; projected, Marietta, Ga., to Atlanta, Ga., 20 miles.

15. *Richmond & Danville.*—Track laid, Statesville & Western Ry., Statesville to Taylorville, 20 miles; under contract, Winston & Wilkesboro R. R., Salem to Wilkesboro 14 miles.—Western North Carolina R. R., Murphy Branch, Jarrets west, 3 miles; also surveyed, end of grade to Murphy, 27 miles; Mocksville branch, surveyed; Winston to Mocksville, 20 miles.

16. *Seaboard Air Line.*—Track laid, Roanoke & Tar River R. R.; Boykins, Va., to Lewiston, 35 miles; under construction, Raleigh & Augusta Air Line R. R. Cameron to Carthage, 10 miles; Durham & Northern, Durham to Henderson, 40 miles; under survey, Carolina Central R. R.; Rutherfordton to Asheville, 50 miles; projected; Asheville to Knoxville, Tenn., 165 miles.

16. *Suffolk & Carolina.*—Track laid; Bosley to Chowan, 11 miles; under construction, Chowan to Montrose Landing, 2 miles.

#### New Projects and Surveys.

17. *Charlotte & Sanford.*—Projected, Charlotte to Sanford, 160 miles.

18. *Clarksville, Blue Ridge & Durham.*—Surveyed, Clarksville, Va., to Durham, 54 miles.

19. *High Point, Randleman, Asheboro & Southern.*—Projected, High Point to Asheboro, 20 miles.

20. *Murfreesboro.*—Projected, from Roanoke & Tar River R. R. to Murfreesboro, 7 miles.

21. *Roanoke & Southern.*—Surveyed, Roanoke Va., to Winston, 90 miles; projected, Winston to Gastonia, 80 miles.

22. *Southern & Western Air Line.*—Under survey, Shelby to Cranberry, 80 miles.

23. *Wilmington, Onslow & East Carolina.*—Projected, Wilmington to Onslow, 50 miles.

24. *Wilmington Sea Coast.*—Surveyed, Wilmington to Wrightsville, 10 miles.

### SOUTH CAROLINA.

#### Existing Roads.

10. *Atlantic Coast Line.*—Under construction, Manchester & Augusta R. R. Sumter to Santee river, 18 miles; under survey, Santee river to Augusta, Ga., 96 miles.

25. *Blackville, Newberry & Alston.*—Under construction, Blackville, north, 25 miles.

26. *Carolina, Cumberland & Chicago.*—Partially graded, Aiken to Asheville, N. C., 200 miles, projected, Asheville to Lexington, Ky., 200 miles.

27. *Carolina, Knoxville & Western.*—Partially constructed, Augusta, Ga., to Newberry, S. C., 115 miles; under survey, Greenville to Knoxville, Tenn., 150 miles.

2. *Charleston, Cincinnati & Chicago.*—Track laid, Camden north, 10 miles; under construction, from 10 miles north of Camden to Blacks, 92 miles; also from Augusta, Ga., to Newberry 71 miles, under survey, Newberry to near Blacks, 80 miles.

28. *Columbia, Newberry & Laurens.*—Under construction, Columbia to Spartanburg, 75 miles.

29. *Eutawville.*—Under construction, Vance's to Waco, 2 miles; surveyed, Waco to Sumter, 28 miles.

30. *Plant Railway System.*—Track laid, Charleston & Savannah R. R., Ravenel's to Young's Island, 6 miles.

18. *Seaboard Air Line.*—Track laid, Palmetto, R. R., Gibson to Cheraw, 10 miles; surveyed, Cheraw to Camden, 57 miles; projected, Camden to Augusta, Ga., 100 miles.

31. *Wilmington, Chadbourne & Conwayboro.*—Track laid, Loris to 34 mile post, 14 miles; under construction; 34 mile post to Conway, 5 miles.

#### New Projects and Surveys.

32. *Eastern, Barnwell & Western.*—Under survey, Columbia to Savannah, Ga., 150 miles.

33. *Orangeburg & Lewiedale.*—Under survey, Orangeburg to Lewiedale, 40 miles; projected, Lewiedale to Prosperity, 20 miles.

### GEORGIA.

#### Existing Roads.

34. *Americus,, Preston & Lumpkin.*—Track laid, Americus to Abbeville, 62 miles; under survey, Abbeville to East Tennessee, Virginia & Georgia Ry., 30 miles; projected to Savannah, 100 miles.

35. *Atlanta & Florida.*—Track laid, Atlanta to Flint river, 13 miles; under construction, Flint river to Fort Valley, 87 miles; projected, Fort Valley to Thomasville, 150 miles.

36. *Augusta & Chattanooga.*—Surveyed, Augusta to Chattahoochee river, 140 miles; projected to Chattanooga, Tenn, 100 miles.

37. *Augusta, Gibson & Sandersville.*—Projected Sandersville to St. Andrew's Bay, Fla., 250 miles.

38. *Birmingham & Atlantic Air Line.*—Partially graded, Macon to Savannah, 160 miles; surveyed, La Grange to Macon, 80 miles, also, Savannah, Dublin & Western Short Line, near Dublin to Americus, 90 miles.

39. *Buena Vista & Ellaville.*—Track laid, La Crosse to Americus, 12 miles; projected, Buena Vista to Columbus, 30 miles.

40. *Chattanooga, Rome & Columbus.*—Under construction, Chattanooga, Tenn., to Rome, Ga., 90 miles; Cedartown to Carrollton, 30 miles; under survey; Carrollton to Columbus, 80 miles.

41. *Columbus & Rome.*—Projected, Greenville to Newnan, 25 miles.

42. *Covington & Macon.*—Track laid; Clinton to Monticello, 25 miles; partially constructed; Monticello to Athens, 60 miles; Monticello to Covington, 25 miles.

43. *Darien Short Line.*—Under construction, Darien to Josephine, 40 miles; projected, Josephine to Milton, 80 miles.

44. *Gainesville & Dahlonega.*—Graded, Gainesville to Chestatee, 16 miles, surveyed; Chestatee to Dahlonega, 10 miles.

45. *Georgia, Carolina & Northern.*—Under construction, Monroe, N. C., to Chester, S. C., 50 miles; under survey; Chester to Atlanta, Ga., 217 miles.

46. *Georgia, Midland & Gulf.*—Track laid, from point 29 miles from Columbus to McDonough, 60 miles; surveyed, McDonough to Covington, 22 miles; projected, Covington to Athens, 30 miles; also surveyed; Columbus Southern R. R., Columbus to Albany, 87 miles.

47. *Georgia Southern & Florida.*—Under construction, Macon to Valdosta, 175 miles; under survey; Valdosta to Palatka, Fla., 125 miles.

30. *Plant Railway System.*—Under construction, Savannah, Florida & Western Railway., Thomasville to Florida Line, 12 miles; Jesup to Hart's Road, Fla., 75 miles; under survey, State line to Tallahassee and Monticello, Fla., 25 miles.

48. *Rome & Decatur.*—Track laid, Rome west, 15 miles, Atalla, Ala., east, 15 miles; under construction, between ends of track laid, 32 miles.

49. *Savannah & Tybee.*—Track laid, Savannah to Ocean City, 18 miles.

50. *Wrightsville & Tenille.*—Projected; Dublin to Cochran, 35 miles.

#### New Projects and Surveys.

51. *Athens & Jefferson.*—Surveyed, Athens to Jefferson, 18 miles.

52. *Atlanta & Alabama.*—Projected, Atlanta to Selma, Ala., 180 miles.

53. *Atlantic, Birmingham & Western.*—Projected, La Grange to Brunswick, 250 miles.

54. *Blue Ridge & Atlantic.*—Projected, Tallulah Falls to Maryville, Tenn., 140 miles.

55. *Chattahoochee Valley.*—Surveyed, West Point to Columbus, 32 miles.

56. *Hawkinsville & Western.*—Projected, Hawkinsville to Perry, 20 miles.

57. *Lexington Terminal.*—Projected, Crawford to Augusta & Chattanooga R. R., 10 miles.

58. *Macon & Alabama.*—Under survey, Macon to Opelika, Ala., 100 miles.

59. *Madison & Eatonton.*—Projected, Madison to Eatonton, 20 miles.

60. *Savannah & Western.*—Projected, Savannah to Eastman, 124 miles.

61. *Washington & Elberton.*—Surveyed, Washington to Elberton, 30 miles.

## FLORIDA.

### Existing Roads.

62. *Alabama, Florida & Atlantic.*—Under construction, Altoona to Indian Springs, 28 miles; located, Indian Springs to Rock Ledge, 40 miles; Projected, Rock Ledge to Biscayne Bay and Altoona to Tallahassee, 430 miles.

63. *Blue Springs, Orange City & Atlantic.*—Track laid, Lake Helen to New Smyrna, 20 miles; under construction, Lake Helen to De Land, 5 miles.

64. *Florida Midland.*—Track laid, Ocoee to Wayco, 7 miles; under construction, Wayco to Kissimmee, 18 miles; under survey, Kissimmee to Rockledge 40 miles; projected, Kissimmee to Punta Rossa, 150 miles.

65. *Florida Railway & Navigation Company.*—Track laid, Withlacoochee River to Plant City, 40 miles.

66. *Jacksonville, Mayport & Pablo.*—Under construction, Arlington to Mayport, 15 miles.

67. *Orange Belt.*—Track laid, Oakland to Mascotte, 17 miles; Macon to San Antonio, 10 miles; under construction, San Antonio to St. Petersburg, 65 miles; Mascotte to Macon, 25 miles; under survey, Lenard to Brooksville, 13 miles.

68. *Orlando & Winter Park.*—Under construction, Orlando to Lake Howell, 10 miles; projected, Lake Howell to New Smyrna 37 miles.

69. *Pierson, Kenwood & Palmetto.*—Track laid, Pierson to Palmetto, 3 miles.

70. *Silver Springs, Ocala & Gulf.*—Track laid, Withlacoochee River to Dunellon, 3 miles; under construction, Dunellon to Homosassa, 15 miles.

30. *Plant System.*—Track laid, Southern Florida R. R., Tampa to Black Point, 10 miles.

71. *Tavares, Apopka & Gulf.*—Track laid, Double Run, south, 20 miles; under construction, end of track to Kissimmee, 23 miles.

### New Projects and Surveys.

72. *Gainesville, Tallahassee & Western.*—Surveyed Gainesville to Tallahassee, 150 miles; projected, Tallahassee to Bainbridge, Ga., 40 miles.

73. *Palatka, Welaka & Lake.*—Surveyed, Palatka to Setter's Lake, 40 miles.

74. *St. Augustine & East Coast.*—Projected, St. Augustine to Daytona, 50 miles.

75. *Suwanee & Gulf.*—Projected, Millen, Ga., to Cedar Key, 250 miles.

## ALABAMA.

### Existing Roads.

76. *Anniston & Cincinnati.*—Under construction Anniston to Atalla, 36 miles.

77. *Birmingham, Georgia & Florida.*—Under construction, Cuthbert to Bainbridge, Ga., 65 miles; surveyed, Birmingham to La Grange, Ga., 110 miles; projected, Columbus, Ga. to Cuthbert, Ga., 50 miles.

78. *Central Railroad of Georgia.*—Track laid, Goodwater to Childersburg, 21 miles; Birmingham, east, 13 miles; under construction, end of track to Childersburg, 30 miles; also, Blakely, Ga., to Columbia, Ala., 13 miles; also Clayton to Ozark, 40 miles; under survey, Carrollton, Ga., to Decatur, Ala., 150 miles; also, Mobile & Girard R. R., Troy to Elba, 40 miles; projected, South Alabama R. R., Columbia to Mobile, 220 miles.

79. *Dauphin Island.*—Under construction; Mobile to Dauphin Island, 32 miles.

80. *East & West Alabama.*—Track laid, Broken Arrow to Pell City, 7 miles.

81. *East Alabama.*—Track laid, Buffalo to Strouds, 12 miles; under construction, Strouds to Roanoke, 5 miles; projected, Roanoke to Anniston, 50 miles.

82. *East Tennessee, Virginia & Georgia.*—Surveyed, Memphis & Charleston R. R., Stevenson, Ala., to Chattanooga, Tenn., 35 miles.

83. *Georgia Pacific.*—Track laid, Coalburg to Cane Creek, 35 miles.

84. *Kansas City, Memphis & Birmingham.*—Track laid, Mississippi State line to Birmingham, 105 miles; under construction, Ensley City to Bessemer, 11 miles.

85. *Louisville & Nashville.*—Track laid, near Birmingham, 40 miles; under construction, near Birmingham, 14 miles; surveyed, near Birmingham to Huntsville, 85 miles.

86. *Mobile & Ohio.*—Projected, Birmingham & Northwestern R. R., Corinth, Miss., to Birmingham, Ala., 150 miles.

87. *Mobile & Birmingham.*—Track laid, Mobile to Choctaw, 96 miles; also, Marion Junction, south, 10 miles; under construction, Choctaw to end of track, 43 miles.

88. *Montgomery & Florida.*—Track laid, McLaren's Mills, south, 20 miles; projected, terminus to Chattahoochee, Fla., 100 miles.

89. *Sheffield & Birmingham.*—Track laid, Russellville, south, 30 miles; under construction, end of track to Jasper, 37 miles; projected, Jasper to Birmingham, 45 miles.

90. *Talladega & Coosa Valley.*—Track laid, Stemly to Pell City, 9 miles.

91. *Tennessee & Coosa.*—Under construction, Atalla to Guntersville, 36 miles.

92. *Tuscaloosa Northern.*—Under construction, Tuscaloosa to Black Warrior river, 5 miles; located, Black Warrior river to Kansas City, Memphis & Birmingham Junction, 50 miles.

### New Projects and Surveys.

93. *Alabama Great Northwestern.*—Under survey, Montgomery to Tuscaloosa, 90 miles.

94. *Alabama Midland.*—Surveyed, Montgomery, Alabama to Chattahoochee, Fla., 170 miles.

95. *Birmingham, Mobile & Navy Cove Harbor.*—Projected, Mobile to Navy Cove, 35 miles.

96. *Cincinnati, Huntsville & Birmingham.*—Projected, Somerset, Ky., to Birmingham, Ala., 335 miles.

97. *Decatur, Chesapeake & New Orleans.*—Surveyed, Decatur, Ala., to Gallatin, Tenn., 143 miles.

98. *Decatur & Columbus.*—Surveyed, Decatur to Columbus, Miss., 120 miles.

99. *Eufaula & St. Andrew's Bay Air Line.*—Under survey, Eufaula to St. Andrew's Bay, Fla., 156 miles.

100. *Florence & Chicago.*—Surveyed, Florence, Ala., to Milan, Tenn., 120 miles.

101. *Florence, Tuscaloosa & Montgomery.*—Projected, Florence to Selma, 185 miles.

102. *Gulf & Chicago.*—Projected, Mobile to Tennessee river, 300 miles.

103. *Macon & Tuscaloosa.*—Surveyed, Macon, Miss., to Tuscaloosa, 60 miles.

104. *Montgomery, Hayneville & Camden.*—Under survey, Montgomery to Camden, 64 miles.

105. *Pensacola & Memphis.*—Under survey, Pensacola to Meridian, Miss., 185 miles; projected, Meridian, Miss., to Grenada, Miss., 130 miles.

106. *Selma & Cahaba Valley.*—Under survey, Selma to Bessemer, 75 miles.

107. *Sheffield & Seaboard.*—Projected, Sheffield to Aberdeen, Miss., 95 miles.

## MISSISSIPPI.

### Existing Roads.

108. *Corinth & Tennessee River.*—Under contract, Corinth to Pittsburg, Tenn., 20 miles.

109. *Gulf & Ship Island.*—Track laid, Cotton Plant to Pontotoc, 25 miles; Gulfport to Biloxi river, 11 miles; under construction, Biloxi river to Hattiesburg, 64 miles; surveyed, Hattiesburg to Carthage, 100 miles; projected: Carthage to Pontotoc, 115 miles.

83 *Georgia Pacific.*—Track laid, Columbus to Starkville, 26 miles.

84. *Kansas City, Memphis & Birmingham.*—Track laid, Tupelo to Alabama State Line, 41 miles; under construction, Amory to Aberdeen, 12 miles.

85. *Louisville & Nashville.*—Projected, Scranton to Moss Point, 3 miles.

111. *Louisville, New Orleans & Texas.*—Projected, Glen Ellen to Rolling Fork, 12 miles; surveyed, Centreville to Woodville, 15 miles.

112. *Natchez, Jackson & Columbus.*—Projected; Jackson to Columbus, 120 miles.

113. *Warrior Coal Fields.*—Under construction, Meridian to Gainesville, Ala., 55 miles; surveyed, Gainesville to Kansas City, Memphis & Birmingham Railway Junction, 75 miles; projected thence to Decatur, Ala., 80 miles.

### New Projects and Surveys.

114. *Artesia, Starkville & Grenada.*—Projected, Starkville to Grenada, 60 miles.

115. *Mobile, Hattiesburgh & Jackson.*—Projected, Mobile, Ala., to Jackson, 175 miles.

116. *Tombigbee.*—Surveyed, Columbus to Decatur, Ala., 131 miles.

## TENNESSEE.

### Existing Roads.

117. *Danville & La Grange.*—Track laid, Danville to Stribling, 6 miles.

118. *Illinois Central.*—Surveyed, Jackson to Memphis, 85 miles; under survey, Cairo to Memphis, 200 miles.

119. *Knoxville Southern.*—Under construction, Knoxville to Louisville, 15 miles; under survey, Louisville to Georgia State Line, 75 miles.

*Lookout Mountain.*—Under construction, Chattanooga to top of Lookout Mountain, 5 miles.

85. *Louisville & Nashville.*—Under construction, Nashville & Florence R. R., St. Joseph to Florence, Ala., 24 miles; also a branch to West Point, Tenn., 11 miles.

120. *Nashville & Knoxville.*—Under construction, Nashville, to Putnam County Line, 55 miles; projected east to connect with Cincinnati Southern R.R., 60 miles.

121. *Nashville & Tellico.*—Under construction, Athens to Bright City, 22 miles, and Nonaburg to Star's Mt. Mines, 8 miles; under survey, Athens to Emory Gap, 35 miles.

122. *Nashville, Chattanooga & St. Louis.*—Track laid, Elora to Huntsville, Ala., 27 miles; also, Jasper Branch, Inman to Dunlap, 12 miles; under construction, McMinnville Branch, to Bon Air Coal Mines, 7 miles; surveyed, Centerville Branch, Aetna, southwest, 18 miles; projected, Jasper Branch, Dunlap to Pikeville, 20 miles.

121. *Powell's Valley.*—Under construction, Knoxville to Cumberland Gap, 63 miles.

124. *Tennessee Midland.*—Track laid, Jackson, west, 5 miles; under construction, end of track to Memphis, 80 miles; also Jackson to Tennessee river, 50 miles; surveyed, Tennessee river to Virginia State line, 400 miles.

125. *Troy & Tiptonville.*—Under contract, Rives to Troy, 6 miles; under survey, Troy to Tiptonville, 30 miles; projected, Tiptonville to Hoxie, Ark., 75 miles.

126. *Walden's Ridge.*—Under construction, Oliver Springs to Clinton, 12 miles.

### New Projects and Surveys.

127. *Chattanooga, Cleveland & Murphy.*—Surveyed, Chattanooga to Murphy, N. C., 75 miles.

128. *Humboldt & Dyersburgh.*—Projected, Humboldt to Dyersburgh, 35 miles.

## KENTUCKY.

### Existing Roads.

129. *Cairo & Tennessee River.*—Under contract, Cairo to Mayfield, 40 miles; under survey, Mayfield to Paris, Tenn., 50 miles; projected, Paris to Florence, Ala., 85 miles.

85. *Louisville & Nashville.*—Indiana, Alabama & Texas Ry., under construction, Cerulean Springs to Princeton, 15 miles; under survey, Gracey to Cadiz, 10 miles.—Cumberland Gap extension, under construction, Corbin to Pineville, 32 miles; under survey, Pineville to Big Stone Gap, Va., 74 miles.

130. *Ohio Valley.*—Track laid, Morganfield to Uniontown, 7 miles. De Koven to Ohio river, 2 miles, Sturgis to Princeton, 45 miles; surveyed, Princeton to Cadiz, 40 miles.

## SUMMARY.

(*Corrected to December* 1, 1887.)

| | Track laid. | Construction. | Surveys. | Projects. |
|---|---|---|---|---|
| *Va.* | 41 | 305 | 304 | 65 |
| *W. Va.* | 41 | 95 | 242 | 485 |
| *N. C.* | 144 | 292 | 537 | 622 |
| *S. C.* | 40 | 583 | 578 | 120 |
| *Ga.* | 214 | 835 | 880 | 1319 |
| *Fla.* | 130 | 214 | 569 | 1037 |
| *Ala.* | 437 | 364 | 1396 | 1465 |
| *Miss.* | 103 | 119 | 185 | 649 |
| *Tenn.* | 89 | 287 | 1190 | 565 |
| *Ky.* | 89 | 564 | 189 | 747 |
| *Total* | 1328 | 3718 | 6057 | 7074 |

### Railroad Notes.

**Culverts.**—For finding the proper water way to give to culverts, the drainage area of the stream should be discovered if possible. The water way may then be calculated by the formula $A = C\sqrt{M}$, in which $A$ is the area of the opening of the culvert in square feet, $M$ is the drainage area in acres, and $c$ is a variable coefficient, depending on the country, about 1.6 in hilly compact ground, and 1 in comparatively flat ground. In mountainous, rocky country, this value may be raised to 4.—*From Cleeman's Railroad Engineer's Practice.*

**Railroad Survey Camp Equipage.**—The commissariat department of a railroad survey through populous districts is of small account, as the party is fed and lodged along the route in hotels or farmhouses; in new country, however, the camp equipage of a party is an important matter and its efficiency depends on experience. The result of very extensive experience is given in *Cleeman's Railroad Engineer's Practice* at length, and should be known to every leader of a survey party, or any engineer who expects to be at the head of a survey.

**The Railroad Engineer's Practice.**—By THOS. M. CLEEMAN is a short but very comprehensive description of the duties of the young engineer in preliminary and location surveys and in construction. The book is now in its third edition; it is only one dollar and fifty cents per copy; the novice in railroad engineering will find it a most valuable assistant; while to the veteran it may convey hints that will repay its study.

## CONSTRUCTION NEWS.

### Water.

**Bunker Hill, Ill.**—With regard to the statement as to the vote on the water-works question (p. 373) Mr. J. C. WRIGHT, City Clerk, writes "There was no vote on Nov. 15 or other date; the proposition remains in status quo. The Council has not been petitioned to submit the question, hence no vote."

**Camden, Me.**—The Camden & Rockland Water Co. has completed its water-works system, supplying Camden, Rockland, Rockport and Thomaston. From April 21 to July 1 the company laid 50,000 ft. of 10-in. pipe, 40,000 ft. of 6-in. and 20,000 ft. of 2-in., put in 65 hydrants and connected 350 services in Camden and Rockport.

**Vandalia, Ill.**—A franchise for laying gas mains in the streets of the city for a term of 30 years has been granted by the City Council to GEORGE W. BROWN and D. M. CLARK, of Vandalia. Work is to be commenced not later than April.

**The Rensselaer Manufacturing Co., Troy, N. Y.**—This company, though comparatively a new one in the valve and hydrant manufacturing line, have prospered sufficiently to warrant an enlargement of their facilities. The city of Cohoes exempts them from taxation for five years as an inducement for them to locate their new shops in that city. The plans have been made and work will be commenced in the Spring. The principal machine shop will be 175 × 43 ft., two stories and basement; the foundry will be 160 × 50 ft.; a boiler house 35 × 40 ft. and tumbling house 44 × 12 ft. An 80 H. P. Corliss engine will supply the power; 200 men will be employed in the manufacture of straightway valves for water, gas and steam, and in scales and brass castings. The contract for grading the grounds has been let to Madigan & Houlihan, Contractors, of Cohoes.

**Nebraska City, Neb.**—On Nov. 16 the City Council unanimously passed a resolution accepting the new water-works, which had already been tested with satisfactory results. The resolution tendered the thanks of the city to the water company, Mr. D. P. ROLFE, President; to Messrs. Comegys & Lewis, of New York, the contractors; to Col. S. H. LOCKETT, the chief engineer for the contractors, and Mr. E. A. RUDIGER, the superintendent of construction. The city has now an ample supply of pure water, with a filtering system and a clear water basin.

**Adrian, Mich.**—

Nov. 23, 1887.

EDITOR ENGINEERING NEWS: I write you in regard to the settlement of difficulties between the works and city which has been effected. The works are to furnish 500,000 galls. per diem in addition to the amount now flowing, and a storage capacity of 1,000,000 galls. in addition to the present storage, on or before Aug. 1888. The city, by resolution Nov. 1, 1887, accepted the mechanical construction as complete under the contract of April 3, 1883, which covers everything but water supply. From Nov. 1, 1887, to such time as the additional supply and storage capacity is furnished, the city pays $250 per month for water for fire purposes and flushing sewers and gutters. When the new supply is furnished as above the city is to pay the contract rental price of $10,000 per annum. The new plant will cost from $30,000 to $40,000. Work will be commenced as early in the spring as possible.

A. F. HAAS,
Superintendent of Water-Works.

**Waterville, Me.**—A system of water-works to supply the towns of Waterville and Fairfield, Me., has recently been completed. The water is taken from the Messalonskee stream and pumped by water-power to a reservoir of over 3,000,000 galls. capacity, situated about 2¼ miles from the pumping station and at an elevation of 217 ft. above the main street in Waterville. The pipes are all cast-iron, furnished by the McNeal Pipe & Foundry Co., of Burlington, N. J. The hydrants and gates were made by the Chapman Valve Manufacturing Co., of Boston, Mass. The pump, which has a daily capacity of 2,500,000 galls., was furnished by the Deane Steam Pump Co., of Holyoke, Mass. The works were designed by Mr. H. G. DENNIS, C. E., of New Bedford, Mass., and James J. Newman, of Providence, R. I., was the contractor. The pipe system was completed and the lines filled on Nov. 24. The system is connected at two different points with the fire service of the Lockwood Manufacturing Co., which comprises one Worthington steam pump of 1,000,000 galls. capacity and five rotary power pumps.

**Brooklyn, N. Y.**—The Ramapo Water Co. has renewed its offer to furnish the city with an adequate water supply. The company proposes to bring a supply from the Ramapo watershed in iron or steel pipes; syphoning the water under the Hudson river, East river and Newtown creek. The elevation of the source of supply is more than 500 ft. above tide. The company proposes to contract for a daily supply of 20,000,000 galls., to be increased as required. Mr. GEORGE A. EVANS is President of the company.

Commissioner CONNER has sent a communication, dated Nov. 28, to the Council, again urging that immediate steps be taken to secure the much needed additional water supply. He states that the present state of water at the Hempstead storage reservoir is only 3 ft. 8 ins. at the gates, and ⅓ of the bottom is dry; its capacity when full is 19 ft. He has had to shut off all watering troughs and issue an official circular to endeavor to prevent waste by consumers. The circular states that the daily consumption has reached 50,000,000 galls., and that the supply is not equal to this amount. The matter was referred as usual to the Water and Drainage Committee.

**Rental Value of Hydrant Service.**—Mr. C. E. CHANDLER, City Engineer of Norwich, Conn., writes us as follows with regard to his paper published in ENGINEERING NEWS, Nov. 19: "If any of your readers would send me the original cost of water-works with which they are familiar, divided into three parts, as suggested by the paper,—i. e., 1st, all extra expense due to use of the water for fire service; 2nd, all extra expense due to the use of water by consumers; 3rd, all the remaining or common expense,—and the annual cost of maintenance divided in the same manner, with the number of hydrants and the amount paid for the use of them, I will tabulate the data for publication, adding columns showing the value of hydrant service figured by both plans suggested in the paper, and will withhold the names of cities or towns if requested to do so."

In the paper above alluded to there occurred two typographical errors. In the 12th line from the bottom of the 3rd column on page 362 for "desired" read "derived;" in the 13th line from the top of the 1st column on page 363, for "$\frac{1}{20}$" read "$\frac{1}{2}$."

**Sewerage.**—*Stafford Springs, Conn.*—The town has decided in favor of the proposed system of sewerage.

*Willimantic, Conn.*—New catch basins are being constructed for the improvement of the present sewerage system.

*Bath Beach, N. Y.*—The Bath Beach Citizens' Association is contemplating a system of sewerage to cost about $100,000. Mr. J. J. POWERS, who put in the sewer system at Coney Island, has been consulted.

*Passaic, N. J.*—A sewerage system is much needed and it is hoped action will be taken by the Council before next summer. The population is nearly 10,000.

*Lancaster, Pa.*—An ordinance has been passed authorizing the issue of bonds for the construction of sewers to drain the north part of the city.

*Key West, Fla.*—Address the mayor for particulars as to the proposed system of sewers.

*Pensacola, Fla.*—The Board of Health has appropriated $15,000 for the sewerage system proposed by Col. G. E. WARING.

*Sherman, Tex.*—A system of sewers will probably be constructed by the Shone Hydro-Pneumatic Sewerage & Water Co., Chicago, Ill.

*El Paso, Tex.*—The city has completed its extensive sewer system, discharging into the Rio Grande, and the city officials of Ysleta, 12 miles down the river, will bring suit to enjoin El Paso from discharging its sewage into the river, as Ysleta takes its water supply from it. The Mexican authorities will also protest.

*Corsicana, Tex.*—A system of sewerage is proposed. For particulars address the mayor.

*Fresno, Cal.*—The city will issue bonds for $100,000 for a complete system of sewerage.

**Water-Works.**—*Maine.*—Orono. A water company has been organized under the charter granted by the last Legislature, and a committee has been chosen to prepare estimates of the cost and consider the feasibility of putting in the works next year.—Augusta. The Augusta Water Co. has completed the reservoir and filled it with water. The reservoir was finished in Nov., 1886, but owing to faulty construction there were several leaks and parts had to be rebuilt under the supervision of Mr. SHEDD, C. E., of Providence, R. I. Water has been let into the street mains.

*Rhode Island.*—Pawtucket. An ordinance has been adopted appropriating $150,000 for a new pumping engine and station. Mr. EDWARD DARLING is Superintendent.—Block Island. Water will be piped from Sand's pond, which has an elevation of 125 ft. above sea level, to the landing, to furnish a supply to the village. EDWARD S. PAYNE, T. H. BALL and F. A. ROSE are interested.

*Massachusetts.*—Winchendon. A committee has been appointed to investigate the question of a water supply and will report in March.

*New York.*—Syracuse. The Council has refused to grant a franchise to the Salmon River Water Co.

*New Jersey.*—Bound Brook. A survey for a water supply from Chimney Rock stream has been made by Judge THOMPSON, C. E., of Bound Brook and ASA HORN, C. E., of Lambertville. They report the project practicable. The dam will be above Buttermilk Falls and will probably be built this winter. The pipes will be laid as early as possible next spring. The cost of the works is estimated at from $20,000 to $25,000.

*Pennsylvania.*—Washington. The Citizens' Water-Works Co. has its works under contract and construction has been commenced. The cost will aggregate over $100,000. The contractors for pipe laying are J. R. De Witt, Jr., and C. J. & A. Coon.

*Maryland.*—Towsontown. The artesian well is still being bored. Surveys have been made for a reservoir. —Salisbury. There has been some discussion as to the legality of the franchise granted to J. A. Cloud & Co., of Philadelphia. The firm, however, will proceed with the works, and state that they will hold the town for damages if other works are authorized. They will probably not be interfered with.—Chestertown. A new engine has been put in at the water works.

*Ohio.*—Glendale. The water committee has secured a guarantee of $1,200 for an artesian water supply.—Fostoria. The vote taken Nov. 25 resulted in 526 favorable and 7 in opposition. The works will be built by an Eastern firm and the city reserves the privilege of buying them after 5 years.—Westerville. Water-works are contemplated.—New Lisbon. The contractors have been granted an extension of time. Two wells have been driven on the South Side, from which water will be pumped into the old reservoir.

*Virginia.*—Norfolk. The council has had under consideration several propositions for increasing the capacity of the water-works and filtering the water. No plan has been decided upon.

*Kentucky.*—Elkton.—Water-works are contemplated. Address J. F. BELL.

*North Carolina.*—A proposition to build water-works has been made by F. C. FIELDS. Estimated cost between $50,000 and $60,000.—Greensboro. The town has accepted the proposition of Mr. KROOM to build water-works.—Asheville. The new water-works are proving quite satisfactory.—Hendersonville. A vote as to the building of the proposed water-works will be taken Jan. 2.

*Michigan.*—Owosso. Water-works are to be put into this city soon. Address C. MCCORMICK.—Lake Linden. The new water-works are completed.—Gaylord. At the vote taken Nov. 15 the question of establishing water-works was carried by a large majority. No action has yet been taken in regard to putting them in. Address T. B. WILLOUGHBY, Village Clerk.

*Illinois.*—Hillsboro. The water committee mentioned last week has engaged Mr. W. B. COATS, C. E., of Kalamazoo, Mich., as engineer to prepare plans and specifications for a system of water-works to cost about $30,000.—Fulton. The water-works have been completed and tested.—Clinton. The well has been finished and yields a daily supply of 200,000 galls.—Centralia. The committee appointed to investigate the question of a water supply has engaged Mr. GEO. C. MORGAN, C. E., of Chicago, to prepare plans for a system of water-works.

*Kansas.*—Arkansas City. The Arkansas City Water Co. has increased its capital stock from $100,000 to $150,000.—Wichita. The new water-works are completed and in operation.—Ulysses. A water company has been organized and will put in works next summer.—Junction City. The new works have been tested, with satisfactory results. Streams were thrown 80 ft. high by pressure from the reservoir, and 180 ft. by direct pressure. There are 50 hydrants at an annual rental of $3,000. The works are owned by the city and cost $49,000, $1,000 less than the engineer's estimate.

*Nebraska.*—Crete. A contract has been awarded for water-works.—North Platte. The water-works will not be completed this year, owing to the inability of the contractors to get the pipe.

*California.*—Anderson. The Anderson Water Co. has commenced work, and will furnish a supply within 3 months.

*Texas.*—Bonham. The city has voted to issue bonds for $30,000 for water-works. The supply will be drawn from gang wells, work on which will be commenced at once.

### Proposals Open.

**Water-Works.**—A system of works. THE CITY CLERK, Greenville, Tex.

**Reservoir and Pumping Engine.**—For the water-works, W. B. LAWRENCE, City Hall, Charleston, S. C.

**Street Railroad.**—About 7½ miles of road. J. G. BRADY, Tuskaloosa, Ala.

**Sewers.**—Work will be advertised shortly. THE MAYOR, Selma, Ala.

**Foundation and Tank.**—Stone foundation for water tank; also substructure and building for iron tank. JAMES BROWN, Comptroller, Allegheny, Pa. Dec. 5.

**Grading.**—Street grading. ST. A. D. BALCOMBE, Chairman, Board of Public Works, Omaha, Neb. Dec. 5 and 6.

**Sewers.**—Branch sewers. LOUIS WAGNER, Director, Department of Public Works, Philadelphia, Pa. Dec. 6.

**Supplies.**—Bolts and nuts, brass steam fittings, wrought-iron pipe, cast-iron pipe and specials, castings, etc. LOUIS WAGNER, (as above), Philadelphia, Pa. Dec. 6.

**Street Cleaning.**—Street cleaning, removing ashes, etc. LEWIS WAGNER, (as above), Philadelphia, Pa. Dec. 9.

**Bonds.**—Town bonds for sewers, $66,000. JOHN Y. MCKANE, Supervisor, Town Hall, Gravesend, L. I. Dec. 14.

**Water Meters.**—The Committee on Water-Works, Toronto, Canada, has received the following proposals.

| Name of Bidder. | ⅝ inch. (100). | ¾ inch. (50). | 1 inch. (25). | 2 inch. (6). | 3 inch. (6). | 4 inch. (6). | Deposit. |
|---|---|---|---|---|---|---|---|
| H. R. Worthington, New York | $1,894.00 | $1,240.00 | $860.00 | $293.00 | $637.00 | $1,980.00 | $155.00 |
| W. H. Banfield, Toronto, (Worthington pattern). | 12.80 | 27.40 | 29.00 | 48.80 | 97.82 | 276.00 | 145.00 |
| W. H. Banfield, Toronto, (Crown pattern) | 13.65 | 21.60 | ..... | ..... | ..... | ..... | ..... |
| Wilson & Cousins, Toronto, (Worthington) | 13.95 | 20.60 | 24.75 | 40.75 | 89.30 | 295.00 | 150.00 |
| Charles Smith & Co., Toronto, (Crown) | 13.00 | 20.00 | ..... | ..... | ..... | ..... | 57.50 |
| National Meter Co., (Crown) | 13.50 | 22.50 | 30.00 | 75.00 | 150.00 | 300.00 | 159.37 |

**Lumber.**—Kyanized spruce plank, 420,000 ft. B. M. Full particulars of the City Engineer, Boston, Mass. THE COMMISSIONERS OF HARVARD BRIDGE, City Hall, Boston, Mass. Dec. 10.

**Bridge.**—Ten spans of 20 ft., across the Platte river. CHARLES H. SCOTT, County Clerk, Denver, Col. Dec. 12.

**Excavation and Pile Foundation.**—For the public building at Key West, Fla. THOS. D. LISTER, Acting Supervising Architect, Treasury Department, Washington, D. C. Dec. 14.

**New Croton Aqueduct.**—Gate house superstructure, roof and floor system for the blow-off chamber at South Yonkers, on Section No. 9. JAMES C. SPENCER, President, Aqueduct Commissioners, 280 Broadway, New York City. Dec. 14.

**Suction Pipe.**—Extending the suction pipe of the water system at the New Orleans Marine Hospital. H. R. CARTER, Surgeon in Charge of Hospital, U. S. Treasury Dept., Marine Hospital Service, New Orleans, La. Dec. 15.

**Revetment.**—At Ashland, Wis.; about 4,300 ft. of pile revetment. Capt. CHAS. E. L. B. DAVIS, U. S. Engineer Office, Milwaukee, Wis. Dec. 20.

**Court House.**—At Lincoln, Neb. Architects, E. E. MYERS & SON, Detroit, Mich. O. C. BELL, County Clerk, Lincoln, Neb. Jan. 3.

## Contracting.

**Steel Rails.**—The Chattanooga, Rome & Columbus R. R. Co., J. D. WILLIAMSON, President, Rome, Ga., will advertise shortly for proposals for steel rails.

**Jail.**—The contract for the jail at Waxahachie, Tex., has been awarded to the Pauly Jail Building & Manufacturing Co., of St. Louis, Mo., for $44,000.

**Artesian Well.**—The contract for drilling an artesian well to give a water supply at Glendale, O., has been awarded to the Bradford Pump Co., of Cincinnati, O., at $2.75 per ft.

**Wind Mill and Tank Wanted.**—The city of Marianna, Ark., wants to buy a wind mill and a tank of about 1,000 barrels capacity. Address B. M. BARRINGTON.

**Pumping Engine.**—The Water-Works Trustees of Columbus, O., have rejected all the bids received Nov. 1 for a pumping engine with a daily capacity of 15,000,000 galls. and will readvertise. A list of the above bids was given in ENGINEERING NEWS, Nov. 5.

**Railroad Shops.**—The contract for the extensive shops of the Louisville & Nashville R. R. Co. at Decatur, Ala., has been awarded to Morris & Newman, of Indianapolis, Ind. There will be 14 buildings, all of brick, stone and iron.

**Street Lighting.**—At Buffalo, N. Y., the gas companies bid $1.35 per 1,000 cu. ft. for lamps in the respective districts, and 17 cts. per month for cleaning and repairing each lamp. The bids for electric lighting were from the Brush Electric Light Co., U. S. Electric Light Co. and the Thomson-Houston Co.; the bids were 47½ cts. per light per night for 2,000-candle power arc lights.

**Supplies.**—The following contracts have been awarded by the Paymaster General, U. S. N., Navy Department, Washington, D. C.: brick, Albert Fiegler, $7.40 per 1000; granite, Berry & McFrederick, $2,500; cement, J. G. & J. M. Waters, $1.12 per bbl.; sand, R. M. Muller, 12 cts.; broken stone, A. F. Carman, 25 cts.; lime, P. Dodge, 73 cts.

**Grading.**—The following proposals for grading were opened Nov. 21 by Capt. J. W. JACOBS, Asst. Q. M., U. S. A., Atlanta, Ga.: J. A. Rooney, Paterson, N. J., 16½ cts. per cu. yd.; R. T. Martin & Co., Chattanooga, Tenn., 17 cts.; J. R. Davis, Atlanta, 19 cts.; C. W. Sullivan, Atlanta, 19 cts.; H. O'Neal, Atlanta, 20 cts.; R. L. Staussell, Atlanta, 22½ cts.; Wm. McConnell, Atlanta, 22½ cts.; J. W. McGinty, Atlanta, 25 cts.; E. Murphy, New York, 33 cts.; F. H. Smith, New York, 45 cts.

**Water Valves.**—Proposals were opened Nov. 21 by Col. WM. LUDLOW, Engineer Commissioner, Washington, D. C., for two 20-in. valves, five 12-in., two 10-in., sixteen 4-in., sixteen 3-in. and twelve 6 in. 3-way valves. The bidders were as follows: Post Valve Co., 163 Albany street, Boston, Mass.; T. Somerville & Sons, Washington, D. C.; Rowland A. Robbins, New York; Chapman Valve Manufacturing Co., 112 Milk street, Boston, Mass.; Jonson Foundry & Machine Co., New York; Robt. Leitch & Sons, Washington, D. C.; Morris, Tasker & Co., Philadelphia, Pa.; Ludlow Valve Manufacturing Co., Troy, N. Y. The totals ranged from $756 to $1,165.

The following is the report of the Superintendent:

TORONTO, November 16th, 1887.

*To the Chairman and Members of the Com. on Water Works.*

GENTLEMEN.—In reference to the tenders for the water meters required by the Department, I would respectfully recommend as follows:

For the ⅝ in. and ¾ in. meters, what is known as the "Crown meter," and for the 1in., 2in. and 3in., what is known as the "Worthington meter"; these meters have both been thoroughly tested by the Department and found very satisfactory.

I would also recommend the acceptance of their respective makers, namely, for the Crown meter, the National Meter Company, of New York, and for the Worthington meter, H. R. Worthington, New York, for the reason that these meters have given better satisfaction than those made by the Canadian manufacturers of the same pattern, which is accounted for by the fact that the most delicate working parts are made of a composition, the secret of which the Canadian manufacturers are not in possession of. This applies more especially to those of the Worthington pattern. I do not think any meters of the Crown pattern have been made in the city, so that it would be in the light of an experiment with this meter, and as the working parts of the Crown meter are also made of a composition, I think it would be advisable to procure these meters from the patentees and original makers.

All of which is respectfully submitted.

WM. HAMILTON *Superintendent.*

The Committee therefore recommended that the contract for 100 ⅝-in meters at $13.50, and 50 ¾-in. meters at $22.50, both sizes of the "Crown" pattern, be awarded to the National Meter Co.; also that the contract for 251-in. meters at $860, 6 2-in. meters at $293, and 6 3-in. meters at $637, all of the Worthington pattern, be awarded to Henry R. Worthington, of New York. The report has been adopted in Council.

**Railroad Contracts.**—*Macon Air Line R. R.* P. T. Hurst, of Albany, Ga., has a contract for 26 miles, and has commenced work.

*Georgia Central R. R.*—Wright & Strothers, of Birmingham, Ala., have a contract on the Clayton extension, from Clayton to Ozark, 40 miles.

*Louisville Southern R. R.*—Mason, Gooch & Hoge, of Louisville, Ky., have the contract for tracklaying to Harrodsburg.

*Clinch Valley R. R.*—J. P. Cash, of Liberty, Va., has a contract for 5 miles of road.

*Chattanooga, Rome & Columbus R. R.*—L. Rossiter, of Talliapoosa, Ga., and M. Howard, of Rome, Ga., have contracts for this new road.

*Charleston, Cincinnati & Chicago R. R.*—H. Lumsden, of Johnson City, Tenn., and J. H. Whitney, of Anderson, S. C., have contracts for grading.

*Knoxville Southern R. R.*—Cawood & Co., of Knoxville, Tenn., have a contract for grading.

*Nashville & Knoxville R. R.*—Davis & Canty, of Lebanon, Tenn., have the contract to complete the 14 miles of work east of Lebanon.

*Durham & Northern R. R.*—P. Linehan & Co., of Raleigh, N. C., have the contract for grading, trestling and cross ties on 22 miles.

*Atlantic Coast Line R. R.*—A. H. Smith, of Scotland Neck, N. C., has the contract for 8 miles of the Scotland Neck extension; 15 miles more will be put under contract as soon as the surveys are completed.

*St. Louis, Alton & Terre Haute R. R.*—N. W. Irish, of Carlisle, Ill., has the contract for grading the Cairo Short Line.

*Davenport, Iowa & Dakota R. R.*—The contract for grading, trestling and cross ties on 10 miles of road, has been awarded to Judge E. H. Williams, of Clayton county. It is said that trains will be running to Independence, Ia., within a year.

*Denver, Texas & Fort Worth R. R.*—B. Rosenfeld & Co. of Pueblo, Col., have the contract for grading the road into Pueblo and grading the depot grounds. The work will occupy 6 weeks. The contract is for about $53,000.

*Lehigh Valley R. R.*—The contract for the construction of the Roselle & South Plainfield Railway, 10 miles of double track, has been awarded to Chas. McFadden. The roads starts at South Plainfield station, on the New Jersey division, and runs to Roselle, N. J., where it connects with the Central Railroad of New Jersey.

**The Bradford Well & Pump Co., of Cincinnati, O., has been incorporated with a capital stock of $25,000.**

**Sewerage of Brockville, Ont., Canada.**

BROCKVILLE, Ontario, Nov. 21, 1887.

EDITOR ENGINEERING NEWS:

Surveys and plans were made in 1885 and 1886 by the City Engineer. These plans were submitted to Col G. E. WARING in May, 1886, who after a persons examination outlined a scheme of sewerage, the separate system with flush tanks, etc. The main outlet as proposed by Col. WARING was located 1,000 ft. out into the St. Lawrence river, but above the intake of the water-works, which is only 300 ft. from shore. The surface inclination of city is towards the west, the fall being about 100 ft. in a mile, and if the currents could be depended on to carry the sewage matter past the intake of the water-works, Col. WARING's scheme would, if safe, be the cheapest plan. Another outlet was proposed and proposal submitted to Prof. GALBRAITH, of Toronto School of Engineering; with this scheme a main intercepting sewer was proposed to be laid along the front of the city from west to east and emptying below the water-works. This scheme is no more expensive than that proposed by Col. WARING. It was reported on as practical by Prof. GALBRAITH. In February, 1887, a by-law was voted on by the property owners, which provided part of the funds to carry on the sewerage works according to Prof. GALBRAITH's plan. This by-law provided that the cost of each sewer should be borne as follows: 40 cts. per ft., to be assessed on each side of the street on all the property fronting on the street, the balance of cost to be paid out of the general funds. The by-law, however, was defeated. In July, 1887, Mr. G. S. PIERSON, of Kalamazoo, Mich., visited the city and prepared a report and plan modifying details in WARING's general scheme and GALBRAITH's intercepting scheme, and in October the Council appointed three Sewer Commissioners to construct the main intercepting sewer, and a small main sewer in the west end which could not be connected with the main system. Tenders were called for labor and for materials; 1st, for 18-in. pipe sewer, 1,600 ft. long; 2nd, for 8-in. pipe sewer, 1,250 ft. long.

*Tenders for Labor, Excavating, Pipe Laying, and Back Filling.*

| | Chapman. | Ryan. | Hagarty. | Swartwout & Palladino. | Wood & Logan. |
|---|---|---|---|---|---|
| Price per foot for 18-in. sewer | $ 1.97 | $ 0.80 | $ 1.25 | $ 0.58 | $ 0.80 |
| Additional price for rock | 3.20 | 3.50 | 2.00 | 3.40 | 3.00 |
| Price for each manhole | 27.00 | 12.50 | 20.00 | 5.00 | 20.00 |
| Average depth, 12 ft. | | | | | |
| Price per ft. for 8-in. sew'r | 1.79 | 0.20 | 1.00 | 0.48 | 0.60 |
| Additional price for rock | 3.79 | 5.50 | 3.00 | 3.40 | 2.75 |
| Price for each manhole | 22.00 | 12.50 | 18.00 | 3.00 | 15.00 |
| Price for each lamphole | 9.50 | 6.50 | 5.00 | 2.00 | 5.00 |
| Average depth, 7½ ft. | | | | | |

The contract was awarded to Wood & Logan, of Brockville, and work was commenced Nov. 21. The river is now about 2 ft. below average level and it is intended to get as much done as possible while the river is low, as part of the main sewer is to be below average water level.

The tender of Messrs. Steben & Barsalow, of Brockville, for materials, was accepted by the Commissioners: the amount of their tender for supplying and delivering all materials being about $1,900. The main submerged outlet 800 ft. long will be laid this winter; depth of water 50 ft.

WILLIS CHIPMAN,
City Engineer.

## RAILROADS.

On account of the space occupied by the list of the railway extensions in the Southern States, we omit this week the usual page of railroad news. Some of the most interesting items of the week we condense: The Pennsylvania has surveyed an extension of the Medford road to Manahawken, N. J., 26 miles, giving a short line from Philadelphia to the seashore.—The Rutland Railroad extending from Bellows Falls, Vt., to Burlington, 120 miles, has been leased to the Delaware & Hudson Canal Co. Rumors of consolidation of the Fitchburg, Cheshire and Delaware & Hudson are in circulation.—The Reading receivers are to turn the property over to the company on Jan. 2.—The Old Colony has leased the Providence, Warren & Bristol.—The Bangor & Castine (Me.) Co. wants estimates from contractors for building 30 miles. JAS. ADAMS, Bangor, President.—The Roselle & South Plainfield extension of the Lehigh Valley, 10 miles of double track, is under contract.—The last rail was laid Nov. 20 on the Canadian Pacific extension to Sault Ste. Marie. On the same day the Grand Trunk engineers finished their preliminary survey to the Sault. The Minneapolis, Sault Ste. Marie & Atlantic will be finished by Dec. 15. Seven spans are up of the International bridge.—The name of the Arizona Narrow Gauge has been changed to the Tucson, Globe & Northern. Work is to be pushed on the extension to Globe. C. P. WALKER, of Tucson, is Chief Engineer.